INVESTIGATING THE USE OF *DESTINATION MATH*

IN AN URBAN SCHOOL DISTRICT

A Dissertation

by

WILLIAM DAVID TELFORD, JR.

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2011

Major Subject: Educational Administration

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Approved by:

Co-Chairs of Committee,	Virginia Collier
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ABSTRACT

Investigating the Use of *Destination Math* in an Urban School District. (August 2011)

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Co-Chairs of Advisory Committee: Dr. Virginia Collier
Dr. Homer Tolson

Destination Math was a program utilized by Xcellence ISD. A determination was needed to see if the usage of the software had a significant positive effect on math performance. In this study, the researcher created a student database that included the usage data from the comprehensive mathematics software program, *Destination Math*, and the math residual value, an added value statistic that was derived from the math scores of the 2006 Texas Assessment of Knowledge and Skills (TAKS) test. An analysis was performed to determine if time spent using the *Destination Math* software resulted in differences among student usage level groups in regard to the math residual value (MRV). The researcher also looked at the usage levels of teachers and campuses to determine if there were differences in the MRV for different classifications of usage.

Certain student classifications were added as independent variables. Since *Destination Math* was offered in Spanish, it was theorized that the program might be beneficial to students who were designated as Limited English Proficient (LEP). Therefore, this student classification was included as an independent variable. Because

research existed that provided evidence that some software contained a gender bias, the student classification of gender was also included as an independent variable.

The population for this study included every student in Xcellence ISD in grades 3-11 who took the math portion of the TAKS test during the week of April 18-21, 2006. Altogether, 3177 students were included in the data analysis for this study. This represented 53% of the tested population. Students with no usage data reported by *Destination Math* were eliminated from the study.

While there are a number of cited studies that document score gains with *Destination Math*, this researcher did not find that residual math scores were significantly different among teacher or campus usage groups. While there was a significant difference among the student usage groups, High users exhibited negative MRVs. The results of this study are consistent with another large quantitative study that involved *Destination Math*. This researcher feels that there is an ample number of studies that provide evidence that *Destination Math* can have a positive effect on student math performance. However, the program should not be purchased with the intent to improve significantly the residual math scores.

DEDICATION

This dissertation is dedicated to Beverly, Katherine, and Benjamin. Thank you for your love, patience, and support.

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Thank you to Dr. Collier for staying with me through this long process. I appreciate your supportive words and encouragement. Thank you to Dr. Tolson for helping me rise to a new level of understanding of statistics. I will continue to utilize the skills you have given to me. Thank you to Dr. Burlbaw and Dr. Torres for providing insights and direction to help me produce a better dissertation. Thank you to Dr. Fitzwater for starting me on this path and to Dr. Stark for providing guidance and direction.

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CHAPTER I

INTRODUCTION

In 1981, there was approximately one computer for every 125 students in schools across the United States (Cuban, 2001). This ratio grew to one computer for every 20 students in 1990. By 1998, there was one computer for every six students (Means, 2000). By 2004, the ratio was one to four (Mollison, 2004).

The phrase "computers in the classroom" became synonymous to "a chicken in every pot" for politicians (Dede, 1997). The American public concurred. Ninety percent felt that computers in schools provided a better educational setting for students and 61% of Americans agreed that federal taxes should support programs to place technology in the classroom (Healy, 1999).

Technology, in fact, became a major reform agenda in the United States (Schwartz & Beichner, 1999). Speakers at Congressional hearings espoused the importance of putting more technology in the schools (U.S. Government Printing Office [USGPO], 2000). The education market was so big that demand from a few states could create a market for an item with big profits for the producers (Burbules & Callister, 2000).

Technology reform in the schools did not come cheaply. If the ideal of one computer for every three students was achieved, Dede (1997) estimated the cost could be $94 billion in startup costs and $28 billion in maintenance. In actual expenditures, the United States spent $40 billion dollars on educational technology from 1993 to 2003

This dissertation follows the style of *The Journal of Educational Research*.

(Mann, 2004). As a per pupil expenditure, the average cost for technology was over $100 dollars a year (Hess, 2006).

Dede (1997) felt that the focus on technology attracted a new generation of teachers whose technology skills complemented their pedagogy. In addition, Bennett (1999) claimed that computers were especially good for at-risk students who did not do well in a traditional setting. He cited an 85% passing rate for students in a GED program in Florida that was computer-based. Dede's and Bennett's works were in line with Lowe and Vespestad's (1999) strong belief that students required instruction that utilized technology so they could become productive members of the workplace.

Not everyone was in favor of the money spent for technology. In 1999, the head of the National Association of Elementary School Principals felt that the $20 billion investment in computers nationwide had done little to improve student achievement (Healy, 1999). Funding for technology shifted funds away from other educational programs (Burbules & Callister, 2000). The "techies," and not the teachers, were beginning to control education (Healy, 1999). The unresolved question was whether this shift in resources toward educational technology had resulted in measurable student achievement.

Schools were not utilizing the investment in technology. While computers could be integrated into every subject that was taught (Schwartz & Beichner, 1999), teachers were not using the technology or they were using it in an inefficient manner (Means, 2000). Word processing was the major activity for which teachers used computers. Without staff development, integration did not take place and technology served a limited purpose (Rasmussen, 2001). Stoll (2000) also questioned the effectiveness of computer use by teachers and asserted that computers wasted teachers' time. Stoll argued that the utilization of technology hid the true agenda of reformers, which was to shake up the traditional classroom.

Change became a topic of debate. Schwartz and Beichner (1999) argued that the fear of change would cause many to look for the negative attributes of technology and gloss over the benefits. The researchers felt that there was no sign that the pace of incorporation would slow down and that the role of technology and how it would change schools needed to be examined. Taking a more moderate position, Burbules and Callister (2000) argued that engaging in a "good versus bad" debate about technology created a polarity that kept each side from listening to the other. They argued that computers were a tool and how we used them determined their worth.

The federal government reframed the conversation about technology when President Bush came into office. Former Education Secretary Rod Paige indicated that the discussion had to shift from the number of computers in the classroom to the ability to produce results (eSchool News Staff - 1, 2002a). The No Child Left Behind Act authorized a federal study of software programs (Trotter, 2006b). Programs for reading improvement and math improvement were the focus of the study. Products would be evaluated on their ability to improve student achievement by examining their effect on test scores (Trotter, 2006a).

The researchers from the NCLB federal study did not give results about specific pieces of software. Instead, the results were reported in aggregate form (Trotter, 2006b).

Schools that wanted to see the effectiveness of a certain program would not be able to get this information from the study.

Initial results from the NCLB federal study were released. The researchers showed no link between software use and increased test scores. A follow-up study produced similar results. Administrators were not left with a path to follow (Dynarski et al., 2007). Those committed to technology could make it work. However, purchasing new software programs probably would not result in a dramatic change in test scores.

Research had been conducted before on software effectiveness. However, study data were sparse and the quality of the research was lacking (Valdez et al., 2000). Healy (1999) felt that the few studies that demonstrated links between student achievement and technology use were largely funded by companies with a financial stake in a positive result. She also felt that some studies were flawed because they depended on volunteers, creating a natural bias. Wenglinsky (1998) found numerous problems with the studies he examined. Researchers did not always correlate the standardized test used to evaluate the math software to the content covered by the software program (Haertel & Means, 2000). Murphy, Penuel, Means, Korbak, and Whaley (2002) found that research was lacking on the effectiveness of software.

The evolution of software made some findings about technology’s impact on learning obsolete (Valdez et al., 2000). Contextual factors surrounding technology use affected the ability to generalize to other populations. Research needed to continue on the effectiveness of programs (Bosco, 2003). Many existing studies could not be generalized to a larger population (Agodini, Dynarski, Honey, & Levin, 2003). Research should be conducted by school districts in partnership with universities (Bosco, 2003).

There existed a need for more research to help unlock the potential for technology in schools (Means, 2000). New kinds of research designs were needed to guide potential purchasers of technology through the complex decisions that needed to be made (Burbules & Callister, 2000). Educators needed specific research on program effectiveness to maximize their investment (Murphy et al., 2002).

Statement of the Problem

In 2003, district leaders in two of the largest school districts in San Antonio were researching *Destination Math* to determine if it could serve as a beneficial supplement to the existing mathematics curriculum. In 2004, the director of the San Antonio Urban Systemic Program (USP) decided to invest in this software in conjunction with five member school districts. The Texas Assessment of Knowledge and Skills (TAKS) test was Texas' new assessment instrument. In 2005, fifth grade students would have to pass the TAKS test to be promoted. At purchase, there was not a specific assessment plan to determine if *Destination Math* would improve scores on the new assessment.

The What Works Clearinghouse identified 11 studies that had been performed on *Destination Math* (What Works Clearinghouse [WWC], 2009a). Investigators determined that none of the studies met the standards set for study research. Therefore, the organization was unable to draw a conclusion about a link between the software and student achievement. *Destination Math* was not part of the NCLB federal study entitled "Evaluation of Educational Technology Interventions" that studied the effectiveness of math and reading software. Even if it had been, the data would have been aggregated with the other software that was studied.

Purpose of the Study

Fadel and Lemke (2006) indicated that schools must match the research to their particular areas of need. The National Mathematics Advisory Panel (2008) cautioned educators to make sure that research on a specific software package could demonstrate gains for a given population in a specific domain of learning. *Destination Math* was a program utilized by Xcellence ISD. A determination if usage of the software had a significant positive effect on math performance was needed. Math was a particular problem area in this district. Data from the state Academic Excellence Indicator System (AEIS) report indicated that 17% fewer students in this district passed the math TAKS test than students statewide. Because 17.5% of the students in the district were classified as Limited English Proficient (LEP), one of the subgroups analyzed in the study was LEP students. *Destination Math* allowed students to switch to instruction in Spanish so it could also meet the needs of recent immigrants.

In this study, the researcher created a student database that included the usage data from the comprehensive mathematics software program, *Destination Math*, and the math residual value, an added value statistic that was derived from the math scores of the 2006 Texas Assessment of Knowledge and Skills (TAKS) test. The math residual value and the TAKS test are both explained in more detail in Chapter III. An analysis was performed to determine if time spent using the *Destination Math* software resulted in differences between the usage level groups in regard to the math residual value (MRV).

The researcher also looked at the usage levels of teachers and campuses to determine if there were differences in the MRV for different classifications of usage.

Certain student classifications were added as independent variables. Since *Destination Math* was offered in Spanish, it was theorized that the program might be beneficial to students who were designated as Limited English Proficient (LEP). Therefore, this student classification was included as an independent variable. Because research existed that provided evidence that some software contained a gender bias, the student classification of gender was also included as an independent variable.

Operational Definitions

The terms below were utilized in this research study. Acronyms that were utilized throughout the study are defined here.

Assessment Time – The amount of time a student utilized *Destination Math* to take the assessments that were part of the program.

Campus Usage Level (CUL) – The usage classification label given to the campus based on the total number of hours that students on a campus utilized the program, relative to the size of the student population. Campuses were divided into three usage levels: Low, Medium, and High. The usage data came from a report in the *Destination Math* learning management system.

Classifications – Student groups utilized for the purpose of this study. The three classifications of students were: (a) LEP status, (b) SUL, and (c) gender.

Destination Math – A software package initially distributed by Riverdeep Corporation and currently distributed by Houghton Mifflin Harcourt (HMH, n.d.-a). On the website under *Solutions – Destination Math – Product Tour*, the software is described as: “A comprehensive K-12 mathematics program that transforms math instruction through a highly interactive learning environment that presents even the most abstract concepts with ease” (HMH, n.d.-a, para. 1).

Instructional Time – The amount of time a student used *Destination Math* to work on lessons and other math instructional content.

Limited English Proficient (LEP) – A label given to students when the Home Language Survey indicated a language other than English as the primary language spoken in the home. Students are classified as Limited English Proficient and receive special services from the school unless the parent refuses the services. The label stays with the student until the student reaches a proficiency level defined by the district. At that point, the student is monitored for two years. Students who are monitored are coded in the student information system as F for first year of monitoring or S for second year of monitoring.

Math Residual Value (MRV) – A statistical calculation that utilizes multiple regression to compare a predicted outcome to an actual outcome. This value was calculated by The Inova Center, Ltd. utilizing current and historic math TAKS data.

Student Usage Level (SUL) – Four usage levels were defined: Minimal, Low, Medium, and High. Classification criteria are described in Chapter III.

Teacher Usage Level (TUL) – A label given to each teacher based upon the number of hours logged by the students of the particular teacher. The labels used were:

Low, Medium, and High. The number of hours came from the Teacher Class Usage Report in *Destination Math*.

Texas Assessment of Knowledge and Skills (TAKS) – "Designed to measure the extent to which a student has learned and is able to apply the defined knowledge and skills at each tested grade level" (Texas Education Agency [TEA], 2006b, para. 1).

Total Time – The number of hours a student spent on the *Destination Math* software; this amount is the sum of the instructional time and the assessment time.

Value Added – An assessment strategy that looks at a residual value to determine if a student made gains on a standardized test, in this case the TAKS test. A positive residual value indicates value added. Value added is utilized as an alternative to actual score gains to measure student performance and, in some instances, the teacher's influence on the child's education that year.

Research Questions

1. Do students who exhibit different utilization of *Destination Math* exhibit different math residual values among Student Usage Levels (SULs) of students in grades 3 through 11 in Xcellence Independent School District?
2. Do teachers of students who exhibit different utilization of *Destination Math* have students who differ in average math residual values among all students in grades 3 through 11 in Xcellence Independent School District?
3. Do students at campuses who exhibit different utilization of *Destination Math* exhibit different average math residual values among all students in grades 3 through 11 in Xcellence Independent School District?

4. Do students classified by SUL, LEP status, and Gender exhibit different average math residual values (MRVs) among all students in grades 3 through 11 in Xcellence Independent School District?

Assumptions

Certain assumptions have been made concerning the quality of the data. Initially, it was assumed that the usage data calculated by the software program was accurate. Secondly, it was assumed that the math residual value calculated by the Inova Center was an accurate reflection of the student's performance compared to the student's historical performance and the performance of the district in general. It was assumed that students from the PEIMS database were accurately matched with their usage time and any errors had a negligible effect on the results. It was assumed that usage time represents a student's active engagement with *Destination Math*.

Limitations

This was a sample of convenience. There was no attempt to collect usage data from other school districts in Texas and compare it to a math residual value. The accuracy of the math residual value as a measure of improvement based on a certain intervention could be a limitation.

The amount of time a teacher used *Destination Math* as a presentation tool was not reflected in the usage data for teachers from the *Destination Math* report. However, as the program was in its first year of use in the district and teachers were still learning how to integrate the program, it is likely that the classification of teachers was accurate.

There is no qualitative data in the study. This would have assisted with questions regarding teacher usage. However, the researcher felt that a survey in 2006 may have made the teachers feel like they were being studied and thus could have affected the data for 2007. It turned out that it was not feasible to utilize the 2007 data. A new learning management system (LMS4) was introduced while the district was still using LMS3. Thus, there were two different programs that were collecting usage data. LMS4 was used by some of the middle schools. However, when the program was not working, those schools would switch to LMS3. The Spanish version of LMS4 was not functional until the Spring of 2007. Therefore, some schools only used LMS3 to take advantage of the Spanish version. The use of two different management systems would have made it difficult to aggregate the student data.

In the Fall of 2006, the introduction of *Destination Reading* in the elementary schools created complications for extracting the data. The usage reports now represented the total usage by students of *Destination Math* and *Destination Reading*. There was no way to generate a report for just *Destination Math*. Since all the elementary schools were using *Destination Reading*, the usage data for grades 3 through 5 would have been a combination of *Destination Math* and *Destination Reading*.

Significance of Study

Spending for technology requires accountability. The White House wanted clearer links between technology and test scores. The NCLB federal study contained data, which the researchers explained, showed no clear link between the use of math preparation software and test scores. However, the federal study did not contain the results of individual products. Therefore, school leaders need other sources of information to make intelligent decisions concerning the purchase and use of software products. The results obtained from this study should add to the body of knowledge that exists on the utilization of the software program *Destination Math*.

Organization of the Dissertation

This dissertation is divided into five chapters. Chapter I contains an introduction, a statement of the problem, the purpose of the study, the research questions, the operational definitions, the assumptions and limitations, the significance of the study, and the organization of the dissertation. Chapter II contains the review of the literature. Chapter III contains background information related to TAKS, *Destination Math*, and the implementation of *Destination Math* in Xcellence ISD (XISD). Chapter III contains the population, instrumentation, procedures, and data analysis. Chapter IV contains the results and data analyses. Chapter V includes the researcher's summary, conclusions, and recommendations.

CHAPTER II

REVIEW OF LITERATURE

This study was designed to determine, based on the test results from the Texas Assessment of Knowledge and Skills (TAKS) and utilizing an added value statistic, if the use of a math preparation software entitled *Destination Math* had a significant positive effect on math performance. As an increased amount of money has been allocated towards technology in schools, the importance of accountability and determining what interventions are effective has become an important area for research. Because a large portion of this type of research has been conducted by companies with a vested interest in the outcome, additional investigation from independent researchers without a stake in the outcome is required.

This review of literature is divided into six sections. The first section covers research on the use of technology as it relates to student achievement. Included in this section is a discussion of two of the independent variables that are utilized in this study: LEP Status and Gender. *Destination Math* is the next section. The independent variables of Student Usage Level (SUL), Teacher Usage Level (TUL), and Campus Usage Level (CUL) are discussed in the context of the existing studies. The expenditures for computers in schools is presented and the history of computers in schools is reviewed. A look at the various barriers to successful technology use is covered. Finally, added value and assessment are reviewed. The review of literature concludes with a brief summary.

Technology and Student Achievement

After three decades of computers in schools, it was natural for policymakers to wonder whether the investment had yielded gains on standardized tests (O'Dwyer, Russell, Bebell, & Steeley, 2008). Fadel and Lemke (2006) argued that technology advocates have offered a variety of reasons to underscore the need for technology. The integration of technology into the schools prepared students for the twenty-first century. It helped bridge the digital divide by making all students literate in the language of technology. Computers provided real world applications for academics. Technology increased student engagement. Finally, it was meant to improve test scores. Ultimately, this large investment needed to be measured for success. Test scores provided the most quantifiable avenue for measurement.

Technology costs have usually represented a significant investment by public schools. Some districts used technology as one of many reform strategies to improve test scores (McNabb, Hawkes, & Rouk, 1999). The impact of these expenditures required study. Simkins (2006) indicated that program evaluation must answer three questions: "How does the technology add value? How will you know the technology is working? Is the value added worth the cost – and the risk?" (p. 23). Fadel and Lemke (2006) indicated that schools must match the research to their particular areas of need. Since studies cannot be generalized to all situations, school officials had to find research that matched the demographics of their school (Fadel & Lemke, 2006).

Past failures of technology integration were blamed on teachers. Cuban (2001) pointed out that after teachers (who had no input on the software/hardware purchase) were blamed for poor implementation, they were sent for more training. There was no evaluation to see if the software was good. Murphy et al. (2002) felt that current research was lacking in reference to the effectiveness of software and the ability to implement software programs effectively. Wenglinsky (1998) pushed for a greater link between computer-delivered instruction and improved student performance. Educators needed specific research to show them which programs were effective so investment in technology could yield the greatest gain (Murphy et al., 2002).

The Enhancing Education Through Technology program, also known as Title II Part D, became a focal point for federal funding of technology. Eighty-one percent of school districts depended on the block grant to help meet their technology needs (Murray, 2007). States were using the money effectively to enhance teaching and learning. However, the initial 2007 budget from President Bush contained no funding for the block grant program. Proponents argued that the program should continue to be funded, as it supported the development of curriculum and teacher training (Trotter, 2006a). However, Timothy Magner, director of educational technology at the U.S. Department of Education, said that evaluative research should be based on student achievement as measured by test scores (Trotter, 2006a).

General Benefits of Technology

The Ed Tech Action Network, a lobbying organization for increased federal funding for technology, documented numerous gains attributable to technology.

> Performance on standardized assessments in reading, writing, mathematics and other subjects improves when technology is part of the learning process. Integrating technology into academic subjects results in gains on high-stakes tests that enable schools to meet AYP and performance benchmarks under

> NCLB. A 2004 report by Market Data Research found that schools that fail to meet the AYP requirements are below average in technology use. (EdTechActionNetwork, n.d., p. 1)

The level of support for technology from both the school and school administrators was positively correlated to a teacher's integration of technology in the classroom (Sandholtz, Ringstaff, & Dwyer, 1997).

Sandholtz et al. (1997) found that technology could have an "enduring, positive impact" if used correctly. Proper implementation required that teachers utilized computers as part of the instructional process and that computers were only used when it made sense for the lesson. Computers could be used as tools and could alter the way subjects were taught (Schwartz & Beichner, 1999). Learning objects, such as pieces of video and virtual manipulatives, could be integrated into the curriculum (Fadel & Lemke, 2006). Computers allowed new learning concepts, such as three-dimensional imaging, to become a part of instruction (Blystone, 1998). Mathematic concepts could be modeled with emerging software (Trotter, 2007b).

Simkins (2006) asserted that utilizing technology could increase the depth of learning and computers were more effective at addressing individual student needs. New software systems tailored instruction to the student (Levin-Epstein, 2004). According to the report by the Educational Technology Expert Panel, *Exemplary and Promising Educational Technology Programs 2000,*

> Technology affords new ways of teaching established disciplines that are likely to be more effective for more students; equally important, technology can inspire teachers and students alike to move beyond conventional content and deepen the process of learning in various disciplines. (Simkins, 2006, p. 23)

As students became proficient with technology, their self-esteem increased (Sandholtz et al., 1997). These students were viewed in a more positive light by peers, parents, and teachers. They could utilize their skills in technology to offer assistance to others. Indeed, gaining skills in information technology was essential to preparing for a future in a technological workplace (Lowe & Vespestad, 1999).

Schools needed to prepare young people for acclimation to the work force by providing the necessary skills and training. The projection that skills in technology would be needed to survive in the twenty-first century came from the U.S. Department of Commerce in a report in 1995:

> As computers and advanced telecommunications are now essential tools in the workplace, it will become increasingly important that individuals obtain the necessary training and education to become computer literate and to be able to 'navigate' information networks. . . . it is estimated that 60 percent of the new jobs in the year 2010 will require skills possessed by only 22 percent of workers today. (Spagnolo, 1997, p. 3)

Integration of technology in the schools had been given credit for making increased productivity in the workplace possible (Valdez et al., 2000). While educational institutions have been criticized for failure to document the successes of technology, initial attempts to track the effect of technology in business were unsuccessful (Kelly, 2007). It took businesses years to figure out how to best utilize technology in the workplace and how to measure its effect.

In 2006, the company CDW-G commissioned a survey of 1000 teachers concerning their views of technology. Two-thirds of the teachers reported they integrated technology into their classrooms at least twice a week. Fifty-four percent indicated that technology had a profound impact on instruction. Seventy-one percent felt that student academic performance improved with the use of classroom computers. CDW-G first commissioned this study in 2004. Each year, teachers' positive impressions of technology have increased. The writers of the presentation felt that "education is today where business was 20 years ago – on the cusp of radically transforming the learning environment" (CDW-G, 2006, p. 4).

Technology may have the answer to the continuing dilemma of training teachers: online training and learning communities (Devaney, 2007). Online communities can offer support from colleagues or other professionals in the field. On demand tutorials allow teachers instant answers and solutions to the technology questions. Also, technology assistance can be accessed at home, outside of the time constraints of the work day.

Student Achievement

Learning and achievement have different definitions. Bosco (2003) defined school achievement as "that which is measured by achievement tests" (p. 9). Thus, math achievement, as it relates to software use, must show an increase in scores on math achievement tests as it relates to software use.

Technology must lead to student achievement in order to continue to receive funding. Wenglinsky (1998) presented the results of a national study that showed the effectiveness of technology for improving math scores. Results on the National Assessment of Educational Progress (NAEP) test were used to measure effectiveness. While a significant positive result was obtained, Wenglinsky (1998) cautioned that the overall effectiveness was dependent upon how the technology was used. Computers were not a blanket cure for the problems in education. Rather, they served as another tool to help students gain mathematics proficiency.

Schacter (1999) reviewed the research of numerous studies that focused on educational technology and student achievement. Most of the studies were chosen for their capacity to generalize to different audiences. Included in the collection were studies by Sivin-Kachala, Mann, and Kulik. Schacter (1999) concluded that educational technologies “show positive gains in achievement” (p. 9).

Sivin-Kachala reviewed 219 studies for his report published in 1998 (as cited in Schacter, 1999). He found positive effects on achievement in technology rich environments. Mann studied fifth graders in West Virginia. In his 1999 study, he noted “a positive effect” between the Stanford 9 test and the West Virginia Integrated Learning System Technology (Mann, Shakeshaft, Becker, & Kottkamp, 1999, p. 48). The four factors, in particular, to have a statistically significant effect were “software access, time students spend with computers, student and teacher attitudes, and principal leadership” (Mann et al., 1999, p. 47).

Kulik (1994) conducted a meta-analysis of 97 individual studies. He reported the following positive findings, based on an average effect size of .35, concerning computer based instruction: (a) average scores on achievement tests increased; (b) students learned material in less time; and (c) student attitudes were more positive when computer-based instruction was utilized. He concluded that there have been too many meta-analyses performed that link student performance to computer-based instruction for this to be a controversial topic.

Kulik (1994) focused on a specific set of studies where tutorial software was the focus. Kulik indicated that tutoring software, “presents material, evaluates responses, determines what to present next, and keeps records of progress” (p. 19). Drill and practice software was a form of tutorial software. Of the 58 studies that fell into this category, he found an average effect size of .38. He felt the effect size led to a reasonable conclusion that computer-based programs yielded better than average results. In comparison to other educational interventions, he found computer-based instruction fell in the middle for instructional effectiveness. The instructional interventions with the largest effect sizes were accelerated classes and classes for the gifted. These educational interventions focused on high-achieving individuals.

Kulik (1994) indicated that the Stanford-CCC program was the only computer-based instructional program that had significant documentation related to it. With almost two dozen studies, the average student made a four-month gain over the course of a year. With an effect size of .4, the variability was smaller and the potential for gains more likely.

Niemiec and Walberg (1992) conducted a meta-analysis and looked at studies from 1975-1987. With an effect size of .42, the average student who had received computer-assisted instruction scored at the 66th percentile. The 50th percentile was the norm.

Waxman, Lin, and Michko (2003) performed a meta-analysis with studies that measured student outcomes in teaching and learning environments that utilized technology. All studies had to contain the proper statistics to calculate an effect size.

Waxman et al. (2003) felt that technology had changed dramatically and more current data were needed to explore the effect of technology on learning. Utilizing 42 studies, they calculated 282 effect sizes that reflected data from 7000 students. With a mean effect size of .41, they found that teaching and learning with technology did have a positive, but small, effect on student outcomes.

Educational researchers have looked at the effects of software packages on specific groups of students. In 1993, Funkhouser looked at the test scores for a group of students who utilized a problem-solving software in Algebra I and Geometry. The students scored higher on the math tests and also showed gains in problem-solving (Funkhouser, 1993). In her dissertation, DiLeo (2007) attempted to find a link between usage levels of Odyssey software in mathematics and language arts and student achievement. She studied 280 fifth graders. She found a significant relationship between the software and student achievement, measured by the Pennsylvania System of School Assessment.

Valdez et al. (2000) argued that technology played a vital role in the education of K-12 students. She found it increased student interest in, and engagement with, learning. Technology made learning more individualized and more interactive. Real world connections also enhanced learning. When implemented systematically, technology led to enhanced student achievement, which could only be partially measured with standardized tests.

The National Mathematics Advisory Panel (2008) explored the effectiveness of computer-assisted instruction (CAI) on mathematical achievement. Utilizing existing research, the panel concluded that CAI can have a positive impact on mathematical performance, though the writers did not present statistical evidence to demonstrate significance. The panel cautioned educators to make sure that research on specific software packages could demonstrate gains for a given population in a specific domain of learning.

Cognitive tutor software is designed to anticipate common misperceptions students may have and provide feedback to explain the correct solution. One example of math software utilizing this strategy is *Cognitive Tutor Algebra*, algebra software designed by Carnegie Learning. It only showed small gains for students taking the SAT test; however, gains for students on tests that measured problem-solving were significant (Kelly, 2007). Researchers contracted by Carnegie Learning found that students did significantly better on an end-of-course Algebra I test than students using a traditional algebra curriculum (Morgan & Ritter, 2002). The researchers utilized random assignment and conducted the study in Moore, Oklahoma. From a survey they utilized, the researchers found that students who used *Cognitive Tutor* Algebra were significantly more confident in their math abilities than the control group.

Cognitive Tutor could also be utilized as an intervention tool. The software could identify a student's weaknesses and then set up an individualized program to address those areas of weakness. The software allowed a degree of differentiation of instruction that was difficult to obtain in a traditional classroom (Nastu, 2007).

The What Works Clearinghouse (WWC, 2004) gave a favorable review of the I CAN Learn math interactive software system, produced by JRL enterprises. There were seven studies available for review. Four were dismissed because they did not meet the evidence screening process. Two met evidence standards with reservations. The researchers who conducted these two studies utilized a quasi-experimental design. A study conducted by Kirby (2004) included 254 eighth grade students, used a randomized control model, and it met the evidence standards of the What Works Clearinghouse. Ninety-one students were in the intervention group and 163 were in the comparison group. The standardized mean difference was 0.41 greater for the intervention group. This equated to a 13.6 mean difference in actual test scores for the experimental group. A follow-up review in 2009 by the What Works Clearinghouse concluded that I Can Learn Pre-Algebra had a positive effect on math achievement (WWC, 2009b).

The What Works Clearinghouse (WWC, 2008) examined Accelerated Math, a product of Renaissance Learning. There were 38 studies available but none of them were randomized controlled trials that met the WWC evidence standards. However, three studies met standards with reservations. The first of these, Nunnery and Ross (2007), found the program to have a positive and statistically significant result for a 6-8 cohort utilizing a quasi-experimental design. Ysseldyke and Bolt (2007) conducted a randomized controlled trial but the study had severe attrition. They found a positive and statistically significant result on one of the two post tests utilized in the study. Ysseldyke and Tardrew (2007) utilized a classroom matched pairs quasi-experimental design. They reported a statistically significant positive gain. However, all three studies contained the following analysis from the WWC (2008):

> After accounting for the misalignment between the school as the unit of assignment and the student as the unit of analysis, the WWC determined that this

> finding was neither statistically significant nor substantively important according to WWC criteria (an effect size greater than 0.25). (p. 4)

Therefore, though three pairs of researchers concluded a positive effect with Accelerated Math, the WWC could not establish a discernible effect from its analysis.

Educational Gaming, a relatively new and little-studied application, was shown to have a positive impact on academic achievement (Fadel & Lemke, 2006). The games maintained the student's attention, offered immediate feedback, fostered higher level thinking, enhanced problem-solving, and reinforced existing knowledge. Many of the benefits were linked to the student's engagement in the activity. Researchers found that gaming improved a student's self-efficacy related to math and the student's overall attitude toward learning.

LEP Status and Software

Bermudez and Palumbo (1994) felt a hypermedia environment was a superior method for educating LEP students. Unlike a textbook, hypermedia allowed students to pursue information in a nonlinear fashion. Rich with multimedia and offering students a choice for their learning direction, hypermedia was a more individualized method of instruction. Defined as "a technology tool for accessing information in a media-rich environment" (Bermudez & Palumbo, 1994, p. 167), hypermedia allowed LEP students to interact with their learning. LEP students benefited from being able to connect graphics, sound, print, and animation.

De La Parte (2000) felt that LEP students needed individualized attention. She indicated that these students tended to withdraw from class discussions. She also asserted that LEP students may not understand the direct instruction and worksheets that were exclusively in English. Computers could provide individualization for LEP students. The computers would enhance the learning, especially if the material could be translated into the student's native language.

Stevens (2000) studied the effects of a specific reading intervention software on LEP students. The students spent their traditional reading time, approximately 120 hours during the year, with the software program. Stevens found significant gains in achievement in both reading and math, based on the Texas Assessment of Academic Skills (TAAS) results, the Texas standardized test of that year. He contended that the advantage of technology interventions was replication between sites. He asserted that technology could make a difference if it was based on sound theory and it was integrated correctly into the specific context of learning.

Hopstock (2003) indicated that there were still questions about the best instructional approach to take with LEP students, even though an enormous amount of research had been performed. He cautioned that all research conducted with LEP students should include: (a) the subgroups of LEP, (b) a definition of LEP, (c) the instructional approach taken with the population, and (d) an explanation of how students were assigned to treatment groups. He suggested that studies consider LEP students and former LEP students as one group when conducting an analysis.

Researchers for the Interactive Educational Systems Design (IESD) (2007) study looked at an intervention in 13 New York City schools. The target population was students identified as Students with Interrupted Formal Education (SIFE). LEP students fell into this classification. The students used *Destination Math* in programs that occurred before school and after school. The writers of the study felt the effect sizes were impressive (.22 for students taking the tests in Spanish and .40 for the students taking the tests in English) for the population being served. The results did not come exclusively from online work, as students did offline work, had individual conferences with teachers, kept journals, and engaged in discussions concerning lessons in *Destination Math*. While the SIFE program was deemed successful, a causal link could not be asserted between *Destination Math* and math achievement as the study had no control group.

Huang (2008) stated that there was still an ongoing debate about whether computer technology can be linked to math achievement. She utilized data from 15,000 tenth grade students who had taken an achievement test and also answered survey questions. Examining the LEP subpopulation, she found a positive, significant relationship between math achievement and the utilization of computers to analyze data in the math classroom. However, she also found a negative, significant relationship between math achievement and how often computers were utilized in the math classroom.

Gender and Software

It was important to know if there existed a gender bias in educational software. In 1991, Hanson (1991) found that there was not a research focus on gender and software. It was apparent, though, that much of the gaming software in the 1990s was more attractive to boys (Beato, 1997). A market actually developed for software for girls. Still, there tended to be little research on gender as it related to computer use in the math classroom (Vale & Leder, 2004).

Campbell (1991) noted that there was a minimal gap between genders related to math achievement. However, Butler (2000) theorized that there might still be a cultural bias that linked boys to math. Thus, since computers were linked to math abilities, boys had a more positive attitude toward computers. Vale and Leder (2004) felt that previous perceptions that math was for boys had shifted to a gender neutral perception. However, they noted that boys were still more confident users of computers. They found that girls showed a less favorable attitude toward software that assisted with math instruction. They linked this more to the favorable attitude of boys to computers than to any attitudes toward math.

Other researchers discovered gender differences. Chuang (1999) found that both genders performed better with software that mixed text, animation, and voice. However, boys performed significantly better. Miller, Schweingruber, and Brandenburg (2001) indicated that the gap between girls and boys was narrowing in respect to computer expertise. They found that boys perceived computers as a toy and were attracted to computer games. Girls viewed computers as a tool and sought out the social function of the machine (Huff, 2002; Miller et al., 2001). Miller et al. (2001) determined that software designers needed to determine how to attract both genders to a piece of software instead of writing software that was gender specific.

Huff (2002) focused on the effects of cross-gender matching of students with software. Among middle school students, he found that stress increased as students used the opposite gender software in a public place. Among novice computer users at the college level, this additional stress only occurred in women.

Sanders (2005) consulted over 600 studies, journals, and articles in her paper on gender issues. She reiterated the findings that boys enjoyed software that contained violence and had a competitive nature, while violent software caused anxiety in girls. Boys enjoyed action-oriented software, and they used computers in their free time to play games and explore online resources. With self-ratings, girls tended to underestimate their abilities with computers. The mere presence of software for girls showed that the existing market of software was geared for boys. However, she pointed out that there was little current research in the area of gender and software.

Beckwith, Burnett, and Grigoreanu (2006) found that the topic of software design as a barrier to females was relatively new. In their study, they summarized current research and pointed out that there were gender differences in learning styles, self-efficacy, problem-solving style, motivation, and information processing style. They found that current software tools designed to help users solve problems were less friendly to the prevailing female learning style.

A Scarcity of Good Research

In the early 1990's, there was little formal research being conducted on mathematics and technology (Kaput & Thompson, 1994). Technology researchers were producing their own journals. Thus, the perception was created that technology was a fringe idea and not part of mainstream mathematics. Twenty-two years later, Fadel and Lemke (2006) wrote, "despite the decades of use of technology in elementary and secondary schools, the number of rigorous research studies is small, the quality of the studies varies considerably, and the level of funding for such research is low in most countries" (p. 16).

Not all research can be used equally to make decisions about the effectiveness of software. Research was considered more rigorous when the researcher utilized an experimental or quasi-experimental design that maintained a treatment group and a control group, preferably chosen at random (Fadel & Lemke, 2006). Descriptive studies use qualitative research and may contain pre/post statistics. However, this type of research cannot be used to determine cause and effect.

Some researchers demonstrated how a specific piece of software embodied the philosophy of a proven educational strategy. Fadel and Lemke (2006) warned that results produced by many studies may not be generalized to other populations or contexts. No individual study could answer all questions, and any study on the national level needed to remain narrow in its focus (Agodini et al., 2003). All studies should include an effect size and the method of implementation in order to generate new knowledge in the field (Murphy et al., 2002).

Wenglinsky (1998) found numerous problems with the studies he examined. Many existing studies were based on exemplary programs and contained methodological problems that would prevent replication. There was an inability to determine which aspect of the program could be responsible for the gains. The results of the studies could not be generalized to other users. The tests utilized to validate the quality of the programs were not always valid. Most researchers did not set up any type of comparison group (Wenglinsky, 1998).

Studies of the effectiveness of software programs on math achievement had critical problems. Some researchers utilized test scores that measured indicators unrelated to the specific areas addressed by the software (Haertel & Means, 2000). Other researchers used surveys to measure client satisfaction with the product, though this was unrelated to specific learning outcomes. One researcher correlated computer access, and not use, to test scores (O'Dwyer et al., 2008).

Many existing studies cannot be generalized to a larger population. The tendency among researchers may be to publish studies with positive results and larger effect sizes (Agodini et al., 2003). These studies were usually small-scale, and the results could not be generalized. Many studies were conducted by the software vendors themselves, and two-thirds of these studies were flawed, keeping them from becoming a part of a meta-analysis of similar programs (Murphy et al., 2002). A review of research revealed that, out of 195 studies that were conducted on different software packages, only 31 contained a design that utilized experimental or quasi-experimental methods (Agodini et al., 2003).

Murphy et al. (2002) outlined the criteria to follow in order to set up a good study. Initially, they felt that there must be a comparison group present. Secondly, they felt it was important that there was a large enough sample size. Third, the study had to include a reliable method to measure achievement. Finally, there had to be sufficient information given in the study to determine the effect size. These criteria form the basis for good quantitative research.

Murphy et al. (2002) insisted that researchers in educational technology must establish criteria for research so that future studies would add to the field of knowledge. A good study, according to Murphy et al., would need to include a combination of quantitative and qualitative strategies in the study design to accurately measure the benefits of educational software (Burbules & Callister, 2000). Valdez et al. (2000) indicated that the amount of research into technology was sparse, and the quality of the research was lacking. They noted that studying technology required a researcher to study a moving target, as software evolution makes older findings obsolete. The context of each study affects the ability to generalize to other populations.

Bosco (2003) asserted that the ideal study, linking student achievement directly to computer use, can never be done. Research must continue to focus on the effectiveness of certain programs. Research must be conducted by school districts or districts in partnership with universities. Research must focus on specific content knowledge as it related to computer use (O'Dwyer et al., 2008).

The Ongoing Federal Study of Software

During the George W. Bush administration (2001-2008), the federal government put the focus of technology on student achievement. Rod Paige, former secretary of the U.S. Department of Education, explained that the focus needed to shift from the number of computers in the classroom to the ability of technology to produce test results (eSchool News Staff - 1, 2002a). New technology funding required applicants to spell out how the funds would increase student achievement (Hoff, 2005). In addition, applicants had to show how the technology would be integrated into the curriculum and the extent of teacher training needed to utilize the technology (Hoff, 2005).

The No Child Left Behind (NCLB) Act authorized a study of software programs. Formulated in 2003, the study, entitled “Evaluation of Educational Technology Interventions” (EETI) utilized random assignment to treatment groups to compare program effectiveness (Trotter, 2006b). This study was one of the few randomized studies that the federal government had ever undertaken.

In order to attract companies to volunteer for the study, the designers indicated that results would only be released to the public in aggregate form (Trotter, 2006b). Critics argued that aggregate results would not fulfill the purpose of the study (Trotter, 2006b). The results would not allow educators to determine which product was most effective. The results would only demonstrate whether software products, in general, produced a net benefit. Effective software products could easily have their performance masked by ineffective products (Trotter, 2006b) as strong results from Company A would be muted by the poor results of Company B. Similarly, ineffective software from Company B would benefit from the aggregation of results.

Agodini et al. (2003) pointed out that the “Evaluation of Educational Technology Interventions” study would ultimately serve as a template for future studies. The study would only answer the question of whether educational technology can improve academic achievement in mathematics and reading (Agodini et al., 2003). Though the focus would be on test scores, other data would be collected that could prove useful in determining the overall effectiveness of the product. Agodini et al. (2003) felt that an additional requirement of the study should be to determine the ease with which educators could integrate the software.

Initial results from the study were not favorable for supporters of technology (Kelly, 2007). The authors of the study found that the influence of technology programs did not significantly increase test scores when compared to control groups using traditional instruction. Kelly (2007) argued that the study did not show that technology cannot be a “powerful learning tool,” only that technology may not be linked to improved standardized test scores in the sample set of schools. He argued that available software did not necessarily produce gains on specific tests; rather, some available products produced limited results on standardized tests but very good results in general problem-solving.

Trotter (2007a) provided details of the study. The original cost of the study was ten million dollars. The study methodology met the rigorous guidelines of the Department of Education with random assignments to both treatment and control groups. The study reflected a real world implementation, as teachers had not used the products before. All the products that were chosen had existing study documentation that indicated effectiveness at raising test scores. Classroom observers visited classrooms at least three times a year to gauge the quality of the implementation of the specific product.

The writers of the study sought out schools that served students with a history of low achievement. Schools in the study had a high percentage of students from low-income families. The existing infrastructure in the schools had to be adequate to support the technology.

The original release date for results was 2006; however, this was moved to April of 2007. The purpose of the study and the main findings were described in the Executive Summary (Dynarski et al., 2007). The researchers wanted to measure the contribution of technology toward student learning. The legislation required that the study use "'scientifically based research methods and control groups or control conditions' and to focus on the impact of technology on student academic achievement" (Dynarski et al., 2007, p. xiii).

There were two main findings from the federal study. Relating to the math side of the study, the findings were: "1) Test scores were not significantly higher in classrooms using selected…mathematics software products… 2) For math products, effects were uncorrelated with classroom and school characteristics" (Dynarski et al., 2007, p. xiii). The study design utilized 33 districts, 132 schools, and 439 teachers. The study limitations indicated that the results cannot be generalized beyond the study's context.

To illustrate the methodology of the study, this researcher examined ninth grade math. Included in the study of ninth grade Algebra I were: (a) *Plato Algebra*, developed by PLATO Learning; (b) *Larson Algebra*, developed by Houghton-Mifflin; and (c) *Cognitive Tutor Algebra*, developed by Carnegie Learning. The algebra study utilized an Algebra I end-of-course exam that was developed by the Educational Testing Service. Because this test was aligned to Algebra I and not a state-mandated curriculum, it was a good measure for knowledge acquisition utilizing the products. The three products were studied in 23 different schools in 10 different districts. Sixty-nine teachers and 1,404 students were part of the study. Final results were corrected for potential classroom and school variables.

A second report looked at whether the software products were more effective during the second year that a teacher utilized them. The second report presented data on the individual products. The students in the study represented a second cohort from the initial study (Dynarski et al., 2007). The report contained information on the implementation analysis conducted in the study. Three implementation findings were described (Dynarski et al., 2007). Initially, nearly all teachers received training and believed the training prepared them to use the products. Secondly, technical difficulties using products were mostly minor. Finally, when products were being used, students were more likely to engage in individual practice and teachers were more likely to facilitate student learning rather than lecture.

With the new price tag of $14.4 million, the follow-up results mirrored the results of the first study. There were few significant differences between students in the treatment group and students in the control group. The algebra programs, *Larson Algebra* and *Cognitive Tutor Algebra*, were able to demonstrate a modest gain with a subset of teachers using the product for a second year. For the programs studied, there was no direct correlation found between usage hours and program effectiveness to raise scores (Viadero, 2009a).

Criticism arose that the study was flawed, even though it met the research requirements set by the federal government's chief researcher. Dynarski (et al., 2007) commented that the criticism may rest more with the result than the study itself. Still, he admitted that the results do not provide a definite path for administrators to follow. Those committed to technology can make it work; those who wish to provide other interventions can feel justified. Those who want a dramatic change in test scores will realize that purchasing new programs is not the answer.

What Works Clearinghouse

The What Works Clearinghouse was established in 2002 by the Institute of Education Sciences to provide access to high quality research for both policymakers and educators (Sparks, 2010). Research had to meet rigorous standards in order to be considered by the organization. Because most research had to include random selection and a control group, few studies could meet the criteria and the organization was nicknamed the "Nothing Works Clearinghouse" (Sparks, 2010, p. 12).

In the Fall of 2010, two additional types of research methods were added to the acceptable list: (a) regression-discontinuity studies and (b) single case studies. Both types were considered friendlier to educational research since control groups in educational settings were rare (Sparks, 2010). Regression-discontinuity allowed a researcher to compare scores of students on either side of a cut-off point. Single case studies required multiple studies before a generalization could be made.

Yan and Slagle (2011) felt that the focus of the What Works Clearinghouse needed to shift from what works for everyone to what is the specific fit for a specific intervention in terms of the population and the setting. They felt that practitioners need to know what will work for them. The What Works Clearinghouse does not comment on the selection of students or on the steps of the implementation process. Instead, the organization focuses on average effects, which only shows that, overall, there is more positive to the intervention than negative; it does not tell if the intervention will work in a specific location. Yan and Slagle (2011) indicated that, more important than telling what works should be telling how to make it work. As a result, they suggested that local districts needed to do more research of their own.

The What Works Clearinghouse examined data from existing studies on *Destination Math* to determine if the software could be successfully linked to student achievement. In March of 2009, the Clearinghouse released its report. Investigators identified 11 studies related to *Destination Math*. They determined that none of them met the standards established by the What Works Clearinghouse to be utilized to draw a conclusion about the software. Six of the studies were eliminated because the researcher did not use a comparison group (WWC, 2009a). Two were eliminated because “the study did not focus on the appropriate age or grade” (WWC, 2009a, p. 2). One study was eliminated because it “did not examine the effectiveness of the intervention” (WWC, 2009a, p. 2). One study was eliminated because “the intervention and comparison groups were not equivalent at the baseline” (WWC, 2009a, p. 2). The last study was eliminated because it “was outside the scope of the review protocol” (WWC, 2009a, p. 2). All 11 studies were included in the next section.

Destination Math

In 2002, eSchool News Staff - 1 (2002a) reported the launch of version 5.0 of *Destination Math,* complete with a new learning management system. A product of the Riverdeep Corporation, the article described the functionality of the upgraded software product:

> a combination of curriculum management, standards-based testing, instantaneous reporting, and prescriptive assignments, giving teachers and administrators the tools they need to guide students toward success by continually evaluating students and linking these evaluations to the software's curriculum. (eSchool News Staff - 1, 2002b, p. 3)

The staff writer pointed out the functionality of the product but did not address its ability to affect student achievement. This would be left to corporate research and independent researchers.

Multiple studies of *Destination Math* took place at the elementary school level. The leadership team at Woodcrest Elementary in California wanted an intervention that would address those students who needed intensive math instruction (HMH, n.d.-b, case study A7517). The team looked for a program that had guided instruction. After *Destination Math* was purchased, the lessons were correlated to the textbook. Teachers received training. Students spent one day a week in a computer lab. In one year, the number of children requiring intensive intervention dropped 11% for second grade, 9% for third grade, and 12% for fourth grade.

Houston ISD implemented *Destination Math* to improve the math abilities of elementary students in a specific high school feeder pattern (HMH, n.d., case study M0327). The students used the program for 20 days in summer school. Staff development focused on integrating *Destination Math* with the summer curriculum. Using a pre/post test means for evaluation, the program saw a 13-point gain in student test scores. There was positive feedback from teachers and students.

Highwood Hills Elementary School in Minnesota utilized *Destination Math* with 19 fifth and sixth grade students (Riverdeep Interactive Learning Limited [Reiverdeep], 2005). The students spent between 12 and 18 hours on the program over a six-week period. Utilizing a pre/post test analysis, the 19 students in the study had a math gain of 378% on a set of benchmark questions. The What Works Clearinghouse could not use the data because there was no control group.

Eaton (2005) wrote about the implementation of *Destination Reading* and *Destination Math* at Fairmont Park Elementary in Ohio. She discussed the full technology integration plan that included supplying teachers with technology, purchasing the Destination Success program, and providing an extensive staff development program. In a pre/post test analysis, reading scores among third graders increased 124%. The What Works Clearinghouse could not include the study because the focus of the research was middle school and this study focused on third grade.

La Joya ISD (HMH, n.d.-b, case study M0325) decided to utilize *Destination Math* on a trial basis. The district wanted to improve the math TAKS scores for third and fifth grade students in a 20-day summer school program. The district leadership liked the program because of the animation and the interactivity and the team felt that it would work well with their students. After the 20-day intervention, third graders had a 15% increase on the post-test. Fifth graders had an 11% increase and LEP students had a 16%

increase. The case study did not indicate whether the post-test was the TAKS test. In Texas, third and fifth graders take the TAKS test a third time over the summer if they have failed it during the first two test administrations. Students attend summer school to receive remediation for the TAKS test, which is one of the criteria for promotion to the next grade level.

Additional studies were conducted where the focus of the researcher was the impact at the secondary level. *Destination Math* was utilized in two schools in the Desert Sands School District (HMH, n.d.-b, case study A7385) in California. There were 127 sixth grade students who were part of the study. The research utilized a control group of 67 students and a treatment group of 60 students. The treatment group utilized the offline work and presentation tools of *Destination Math* for three days a week in a whole group instructional setting. The other two days of the week were spent in the computer lab on *Destination Math*. The study took place for six weeks. At the end, the treatment group outperformed the control group at a statistically significant level. Qualitative data revealed that students in the treatment group were more excited about learning.

Chipman JHS (HMH, n.d.-b, case study A7327) in California had a discrepancy between the scores of its urban students and its suburban students. *Destination Math* was purchased to help close this gap among seventh grade students. All students utilized *Destination Math* twice a week in a lab setting. After two and a half months, those students who were lagging behind were placed in the lab five days a week for intensive instruction. After 45 days, these students were returned to their regular classrooms. Chipman JHS had outperformed state averages in 1999. In 2000, the seventh grade scores increased at a greater rate than the scores on the state level. However, The What Works Clearinghouse could not utilize this data since the control group (state averages) could not be equated to the treatment group.

The leadership team at Palomares Middle School (HMH, n.d.-b, case study A7402R) was displeased with the fact that only 30% to 40% of the students were on grade level. In addition to extensive staff development and a focus on educational technology, the team purchased *Destination Math*. Students who were low-achieving in math were given a math elective class for 55 minutes a day. Students were self-paced with *Destination Math*. After one semester, one-third of the students were exited from the accelerated program after reaching an acceptable level of achievement in their regular math class.

FitzPatrick (2001) explored the implementation of the *Destination Math* program in two eighth grade math classes. The thesis identified barriers that prevented the teacher from expanding the use of *Destination Math*. Fitzpatrick also examined the cognitive level of the questions asked in *Destination Math*. She was positive about the *Destination Math* product, but she was frustrated with the inflexibility of the existing curriculum and schedule that prevented an expansion of the role the software played in learning. The thesis written by FitzPatrick (2001) was dismissed by the What Works Clearinghouse because it did not “examine the effectiveness of an intervention” (p. 2).

Rivet (2001) used four sixth grade classrooms for his data analysis. Two used a traditional method for teaching fractions; two used *Destination Math*. He used a pre-post test model for his study that covered a six-week time span. After six weeks, the experimental group showed a significant gain over the control group. The What Works Clearinghouse indicated the dissertation was ineligible for review “because it does not examine an intervention implemented in a way that falls within the scope of the review protocol” (WWC, 2009a, p. 2).

Taepke (2007) studied the effect of usage time for *Destination Math* on academic grades for middle school algebra students. Her study included 1,452 students over a three-year period. Six teachers were involved. Each year, the group of teachers utilized *Destination Math* to a greater extent. In 2002, usage was classified as “seldom” ; in 2003, it was classified as “occasional”; and in 2004, it was classified as “often” (Taepke, 2007, p. 171). She found that students who received the greatest exposure to *Destination Math* received higher grades in Algebra I. However, *Destination Math* exposure did not correlate to performance on the California Achievement Test. Taepke pointed out that the standardized test was not specific to Algebra. Taepke’s dissertation could not be used by the What Works Clearinghouse because it did not contain a comparison group.

Taepke also utilized *Destination Math* with a group of students at the high school level (HMH, n.d.-b, case study A7325). The class of 23 low-performing students met for two hours each day. Thirty-minutes of that time was spent utilizing *Destination Math*. Taepke utilized other resources from *Destination Math*, including the presentation pieces, during her classroom time. Taepke noted significant improvement in the scores of the students. She felt that this intervention would not have worked for two hours a day without something engaging for students.

Mitchell High School (HMH, n.d.-b, case study A7387) in Colorado was struggling with failures in Algebra I. The school leadership decided to purchase *Destination Math* to address the problem. Students who had failed Algebra I were placed in a computer lab for one period a day for a month. Students progressed at individual levels. Analysis of the data showed statistically reliable gains on a pre/post test model. The What Works Clearinghouse would not consider the study because there was no control group.

Some studies took place at a district level. The New York City SIFE study (Interactive Educational Systems Design [IESD], 2007), mentioned earlier in this chapter in *LEP Status and Software,* found improvement for students who tested in Spanish and English. The study was not considered by the What Works Clearinghouse because there was no control group.

In Pender County, North Carolina (HMH, n.d.-b, case study A7389), district officials made a commitment to improve math proficiency at the secondary level. Teachers were given a variety of training and received mentoring throughout the year. An additional person was hired to help teachers with implementation issues. Teachers also received projectors to utilize the presentation function of *Destination Math*. Teachers utilized *Destination Math* in the classroom at least once or twice a week. At the end of the year, score gains in math had increased at a faster rate than the state average. Students who were surveyed indicated that *Destination Math* made it easier to understand math concepts. The study was not considered by the What Works Clearinghouse because there was no control group.

The White Paper (Duval, 2004) released by Riverdeep presented data on the Victoria School District in Canada, where approximately 2400 students utilized *Destination Math* in 34 schools. Schools in the district had to submit an application with a pledge to implement the program with a minimum group of 20 students. Students utilized the program for approximately seven months for different amounts of time. Those students who had utilized the program for 20-45 hours showed gains in a pre/post test. Students that utilized the program for 10 hours or less did not show gains on the pre/post test. A lack of statistical analysis prevented the researcher from claiming a significant improvement in math scores, based on usage levels. The What Works Clearinghouse did not consider the study because it did not have a control group.

Roberts (2009) prepared the results from the technology implementation plan in the St. Lucie County Public School System in Florida. The district leadership wanted to increase student learning. There was a commitment to investment in technology and products. The district purchased *Destination Success* (Math and Reading), Learning Village curriculum management, and a test bank software. Staff development was ongoing and systematic.

The study of the effectiveness of the program included 1000 students who had utilized *Destination Success* at least three times a week for a given number of minutes. The study design was a stratified random sampling that utilized a pre/post design for evaluation. The data were collected over a five-year period. The researcher of the study credited the initiative for academic improvement on a district level. There was a significant correlation between minutes spent on Destination Success and a benchmark assessment. Schools with the greatest number of minutes usually had higher school ratings. This study was not part of the What Works Clearinghouse review.

Roberts (2009) felt that, even though computer-assisted instruction research was not definitive, the side benefit of instructional technology was increased computer literacy in the student population. He suggested that students utilize Destination Success for 50 minutes a day, every day of the week. The study did not attempt to separate the effect of *Destination Reading* and *Destination Math*.

Riverdeep contracted WestEd to perform an experimental study with fifth grade students (Levenson & De Long-Cotty, 2006). Riverdeep claimed that, given 90 days, students would show an increase in math achievement. Riverdeep recommended that the program be used two or three times a week for 20-30 minutes at a time. Thus, the recommended exposure to the product was 40-90 minutes a week.

Up until this point, Riverdeep had conducted quasi-experimental studies and pre/post studies (Levenson & De Long-Cotty, 2006). It was the goal of the WestEd researchers to conduct a study that would meet the expectations of the What Works Clearinghouse. The study goal was 600-700 students who would receive the intervention for 14 weeks. The study would control for differences in treatment and control groups relative to numerous factors. The size of the research group would be able to produce an adequate effect size.

The study was completed with 331 students (Levenson & De Long-Cotty, 2006). The intervention period varied from 9.5 weeks to 12.5 weeks, with an average intervention time of 11.2 weeks. Weekly contact with the product varied from 55 minutes to 150 minutes. Six of the eight teachers in the treatment group stayed within the 45-90 minute weekly recommendation.

After adjusting for differences, the treatment group had a higher mean score than the control group in Concepts and Estimation and Computation. However, the amount of improvement did not rise to a level of significance. Therefore, the researchers concluded that there was no significant improvement for the students in the *Destination Math* treatment group. This study was not considered by the What Works Clearinghouse because it focused on fifth grade and the What Works Clearinghouse focused on middle school.

Levenson and De Long-Cotty (2006) had conducted a previous study on *Destination Math* and, based on their experience with the program, made suggestions for future studies: (a) sample size should be increased, (b) the dosage should be monitored, (c) the grade range should be increased, and (d) the length of the intervention should increase. The researchers felt there could be negative effects to using the program longer than recommended as the time spent on *Destination Math* as an intervention was often taken away from the traditional math instruction in the classroom.

Expenditures for Computers in Schools

Getting Computers Into the Schools

In 1970, money was not being spent on personal computers in the public schools (Hess, 2006). Personal computers did not start gaining attention until the release of the TRS80, affectionately known as the Trash 80, which emerged on the market in 1977 (The People History.com, 2009). It had a price point at $600. The Apple II also came out in the late seventies. It sold for $1300-$2600, depending upon the amount of memory the owner added. In 1983, an Apple computer sold for $2300 (Oppenheimer, 2003). More computers were entering the schools, though, because of different corporate giveaways and funding programs. In 1996, the Department of Education estimated that it would cost an average of $11 billion a year to pay for the initial investments and the ongoing expenses of technology in the schools (U.S. Department of Education, 1996). Dede (1997) estimated that the cost of putting a multimedia computer at a 1:3 ratio of computer per student would run $94 billion in startup costs and require an additional $28 billion in maintenance and that such an expenditure would drain other programs in the schools.

Despite the predicted high cost, the mood of the country in 1995 favored more computers in the schools (Healy, 1999). Ninety percent of Americans felt that computers would help provide a better education for their children, and 61% favored a tax increase to pay for the technology. In addition, politicians equated computers in the classroom with “a chicken in every pot” (Dede, 1997). Technology was viewed as a cornerstone of America’s educational reform agenda (Schwartz & Beichner, 1999). In this supportive climate, $5.7 billion was spent from 1997 to 1998 on technology in the schools (Armstrong & Casement, 2000). Spending on technology per student rose to $100 in 2004. Overall, in the years from 1993 to 2003, the U.S. investment in educational technology reached $40 billion (Mann, 2004). Conservative estimates for the years from 2001-2006 equaled $5 billion a year (Simkins, 2006).

A large amount of educational funding came from the federal government (USGPO, 2000). A United States telecommunications law was originally set up to provide universal telephone coverage for all Americans. The United States government expanded the interpretation of this law to provide universal internet access for schools, libraries, and health care providers (Bosco, 2003). The provision of the act was called the E-rate Program (USGPO, 2000). Two and a half billion dollars was set aside each year and funds were distributed through the E-rate program beginning in 1998. Total E-rate allocations by February 2001 equaled $5.8 billion in commitments (Cattagni & Farris, 2001). Between 2001-2006, the E-rate provided more than $20 billion to increase school and classroom connectivity to the internet (Hess, 2006).

In the year 2000, the federal government spent $1.5 billion dollars on educational technology through various grants and programs. This equated to between 20% and 35% of the total expenditures on technology in K-12 schools in the United States (U.S. Department of Education, 2000). In 2002, President Bush continued to fund technology for schools by allocating $850 million to this budget item, about the same as President Clinton had budgeted during his last year in office. Members of the software industry expected this funding to continue for years to come (Oppenheimer, 2003).

While technology expenditures per student ranged between $100 and $200 a year, the similar investment among U.S. firms for their companies was between $3500 and $5500 per worker for technology and technology support (U.S. Department of Education, 2000). Even with all the spending to increase technology in the schools, the technology investment did not keep up with the private sector. In addition, corporate use of technology required budgeting to fund the initiative. In large part, school districts had not tackled this issue, as the bulk of the dollars spent came from grants and other temporary sources, not as line items in district funding (Bosco, 2003). Absent these funds, districts would be forced to make budget decisions involving local funds and funding for technology (Webb, 1999).

The Total Cost of Ownership

As more computers were brought into schools, costs extended beyond the purchase of the hardware (Bosco, 2003). Total cost of ownership (TCO) refers to the direct and indirect costs associated with a purchase or investment. In relation to technology, total cost of ownership included connectivity issues, technology support, training of teachers, improvements in the infrastructure, maintenance of equipment (Getting, 1996; Hetzner, 2005; Tomei, 2002; U.S. Department of Education, 2000) and software cost (Punderson, 2001). The Gartner Group found that the TCO in the private sector in the late 1980s came to $8307 per computer (Stallard & Cocker, 2001). School costs were half this amount, but not all districts budgeted for this with the initial purchase of the hardware.

Investment in technology included more than the cost of the computers. New Haven Unified School District in California decided to add seven computers to each classroom (Armstrong & Casement, 2000). Costs included $9 million for fiber optics, $3.1 million for electrical upgrades, and $2.4 million for additional systems and upgrades. The computers and printers cost $800,000.

In 1993, Becker (as cited in Armstrong & Casement, 2000) estimated a cost of $1375 per pupil to cover the personnel costs associated with a meaningful technology program. He estimated the cost of hardware and software at $556. Since technology evolves, a state of the art computer lab can become obsolete in five years (Armstrong & Casement, 2000). Upgrades to existing equipment cannot be considered add-on costs but must be factored in as a regular expenditure (The Education Alliance, 2005).

In the business world, technological innovation led to increased productivity. This was not the case in education. In fact, the opposite occurred. According to Hess (2006):

> In the past five years alone, the nation has spent more than $20 billion linking schools and classrooms to the Internet through the federal E-rate program. Between 1997 and 2004, the federal government appropriated more than $4 billion to help states purchase educational technology. Meanwhile, these huge new investments in technology were coupled with a massive increase in the teacher workforce that drove the student-teacher ratio from 22 students per teacher in 1970 to 16 per teacher in 2001. There is no reputable analysis suggesting that the billions invested in technology have enhanced the productivity or performance of America’s schools. (p. 1)

The trend in education has been opposite to the trend in business (Hetzner, 2005). Whereas businesses used technology to increase efficiency and produce a product at a lower cost (Hess, 2006), the effect of technology on teaching and learning had been less transformative (Negroponte, Resnick, & Cassell, 1997). However, Lemke, Coughlin, and Reifsneider (2009), proponents of educational technology, pointed out that business began experimenting with technology in the 1960s and it took the industry 30 years before productivity increased.

Changed Priorities in Funding

The reauthorized Elementary and Secondary Education Act put a new emphasis on data collection and data reporting. States had to track and analyze student performance (eSchool News Staff - 3, 2002b). School districts were required to make data driven decisions concerning the interventions they chose. This new focus on data required districts and states to shift some technology funds from instructional purposes to data purposes.

In 2003, Texas legislators erased a $10 billion deficit by making dramatic cuts in spending (Borja, 2005). Considered a role model state for its attempts to integrate technology and facilitate technology planning (Murray, 2003), the state technology initiatives were cut $33 million and $75 million in grants for telecommunications were canceled. The Texas Education Agency had to cut the number of employees in its technology department from 20 to 3 (Borja, 2005). In addition, a large number of the Educational Service Centers in Texas lost most of their technology funding. These service centers provided critical support to the small districts of the state.

Texas was not alone with its spending cuts in technology. The State Educational Technology Directors Association (SETDA) reported an average funding drop of $3.5 million from 2002 to 2003 among the 31 states surveyed (eSchool News Staff - 2, 2004). Overall, the growth of spending nationally on technology slowed to 4% in 2004 (Mollison, 2004).

State technology directors cited budget deficits and cuts in Title II, Part D funds as contributors to the financial downturn. Title II, Part D Round 3 funds provided $700 million for technology in fiscal year 2004 (eSchool News Staff - 5, 2007; Lemke, Wainer, & Haning, 2006). Round 4 funds were cut to $496 million. Round 5 funds were reduced to $275 million. In 2004, 70% of states indicated Title II, Part D as a primary fund source (Lemke et al., 2006). Fourteen states indicated that Title II, Part D funds were their only source for educational technology. A lack of sustained funding for K-12 technology and the decrease in the level of excitement regarding technology in schools added to funding woes (Borja, 2005).

President Bush targeted technology for cuts in funding in his 2007 budget proposal. The President felt that technology expenditures lacked the support of research to demonstrate the value of the investment. One particular program had a price tag of 272 million dollars. The stated objective of the program was "to help states and school districts use technology for education" (Trotter, 2006a, p. 10). Congress funded the program, but President Bush slated the funding to be cut in his 2009 Budget (eSchool News Staff - 4, 2008). Susan Patrick, the director of the Education Department's Office of Educational Technology, found value in technology but felt the $40 billion investment over the last 20 years had "yet to realize the true potential" (Mollison, 2004, p. 2C).

The No Child Left Behind Act increased the accountability demands concerning student performance on standardized tests, and the phrase "data-driven decision making" appeared (Pierce & Murray, 2004, p. 1). Across the country, states and local school districts had to collect, manage, and analyze more data (Edwards & Chronister, 2005). The requirements influenced many states to invest in larger data systems to report on student achievement and teacher quality (Hoff, 2005). It also meant that research for all initiatives, including educational technology, had to demonstrate a link to higher test scores (Stallard & Cocker, 2001).

In order to meet federal data requirements, money was spent on data storage and analysis. Fifteen states invested in better data storage systems in order to keep up with federal mandates. The emphasis on data analysis resulted in a shift in spending, away from campus hardware, software, and connectivity and toward data collection tools for keeping track of test scores (Hetzner, 2005; Hoff, 2005; LaCoste-Caputo, 2005). Dollars that were once used to pay for computers in the classroom were shifted to pay for complex data storage and analysis systems (Bushweller, 2005). Budget cuts in 2008 even threatened state data systems (McNeil, 2008).

The History of Computer Integration Into Schools

Computers in Schools and Access to the Internet

In number, there were 50,000 computers in the schools in 1983. This number grew to 2.6 million by 1990 (Means, 2000). The ratio of computers to students in 1981 was 1 to 125 (Cuban, 2001). This ratio has changed throughout the years. By 1995, it had improved to 1 computer for every 9 students (Wenglinsky, 1998). Public schools sought to lower this ratio. By 1999, it dropped to 1 computer for every 6 students (Cuban, 2001). The ratio dropped to 1 computer for every 5 students by the Fall of 2000, a ratio considered by many experts as reasonable for effective computer use (Cattagni & Farris, 2001). By 2004, the ratio was 1 to 4 (Mollison, 2004). The number of computers located in classrooms rose to 1 for every 7.6 students in 2004 (Fox, 2005).

Access to the internet increased also. Thirty-five percent of schools had access to the internet in 1994. This percentage grew to 98% by the end of 2000 (Cattagni & Farris, 2001). Classroom access to the internet also increased. Only 3% of classrooms had access to the internet in 1994. In 1999, this percentage had grown to 80% (Means, 2000). In 2005, 94% of classrooms had access to the internet (Wells & Lewis, 2006). The ratio of instructional computers with internet access to students improved dramatically. In 1998, the ratio was 1 to 12.1. By 2002, it was 1 to 4.8 (Schmitt, 2002).

The expression “digital divide” was often used to discuss the gap between rich and poor students and their access to technology. In 1983, it was estimated that rich schools had twice as many computers as schools that served poorer students. The gap was closed by the year 2000 (Oppenheimer, 2003). However, another gap emerged. In relation to technology, schools that served low socioeconomic populations had more teachers rated as beginners. In addition, computers in these schools were utilized for less rigorous tasks. Though many tired of the expression “digital divide,” it was expected that expensive new technologies would always find their way to more affluent schools first.

Computer Utilization

Computer utilization in the schools has evolved through the years. In the 1960s, Dr. Patrick Suppes was an early advocate for computer-aided instruction (CAI). This type of software became popular in the 1980s and early 1990s (Oppenheimer, 2003). Suppes’ company, Computer Curriculum Corporation (CCC), developed many different software products. Some products would adjust to the learner’s level, becoming easier or harder based on responses that were incorrect or correct.

In the 1990s, computer use and computer languages were being taught as a separate course (Schwartz & Beichner, 1999). Students were not gaining “technology literacy,” the ability to utilize computers to increase productivity and performance (Getting, 1996). Even as late as 1998, most teachers were only using computers for the word processing capabilities and not as a teaching tool (Means, 2000).

The Apple Classroom of Tomorrow (ACOT), begun in 1985, proved the exception to the rule as it altered the existing model for computer integration and attempted to shift the application to authentic learning situations (Murphy et al., 2002).

> The ACOT model represented a shift toward using technology to engage students in more authentic tasks in the classroom. In contrast to being taught programming languages, students in ACOT classrooms learned to use productivity and multimedia software to accomplish their own learning goals. Since ACOT began, new technologies have been developed that allow students to represent ideas, communicate, and collaborate with others outside the classroom. (Murphy et al., 2002, p. 6)

The ACOT project ran from 1985-1995. During that time, the project made many changes in its design (Sandholtz et al., 1997). In the beginning, five sites were utilized across the country. Each student in an ACOT classroom had access to a computer at school and at home. There was not a specific agenda for what needed to occur in the classroom. ACOT wanted to see how classrooms immersed in a technology environment might change. By 1992, the project evolved to a point where summer staff development activities were utilized to train teachers how to integrate technology and create a more constructivist classroom.

Oppenheimer (2003) indicated that the change in ACOT schools had less to do with the computers and more to do with the quality of instruction. Computers facilitated the collaborative learning environment and the ability for students to communicate effectively about complex problems; however, after ten years of the program, there was little evidence of gains in student achievement. Once students left the ACOT environment, any demonstrated improvement disappeared.

ACOT re-emerged in 2008 as $ACOT^2$ – the Apple Classroom of Tomorrow – Today. The new focus was on creating engaging, project-based learning environments to keep student interest. Among the goals of the new program were hopes to decrease the current high school dropout rate.

Impact on Instruction

During the 1980s, there was a dramatic increase in the number of computers in the classroom. However, increased availability did not result in dramatic changes regarding utilization by teachers (Marcinkiewicz & Welliver, 1993). There was a general lack of integration of the technology into the instruction, so the overall impact of computers was minimal.

Welliver (as cited in Cafolla & Knee, 1995) created categories of computer integration so that types of integration could be studied. *Familiarization* indicated that a teacher understood the basic function of the computer and had a general understanding of what the computer could do. *Utilization* related to lessons that were taught with the aid of a computer. However, absence of the computer would not prevent the lesson from being presented. *Integration* denoted those teachers who utilized technology to such an extent that it played an important role in the lesson. It also signaled the subtle transformation of a classroom that moved from a teacher led structure to a student engagement setting. *Reorientation* expressed classrooms and instruction that considered technology when setting educational objectives. *Evolution* signified a future stage, as yet not demonstrated in classrooms.

While the technology would need to catch up to the concepts developed through ACOT, the experiment brought great focus on the need for a different approach to instruction (Sandholtz et al., 1997). Louis V. Gerstener, former chairman of IBM, felt that the transformation of low-tech schools into institutions that mirrored the high-tech society would transform teaching and learning as we know it (Spagnolo, 1997). However, the initial infusion of technology did not cause this transformation to occur. While additional computers may have helped some students become better test takers, the overall effect of drill and skill software was diminishing higher-order cognitive skills (Sandholtz et al., 1997).

Off-the-shelf software was not meeting the needs of educational institutions (Stallard & Cocker, 2001). Specialized software needed to be designed to meet the particular needs of institutions and individual learners. Cafolla and Knee (1995) indicated that multiple issues were stifling computer integration: (a) lack of teacher training, (b) insufficient funding, (c) poor software availability, and (d) resistance to change. They proposed a shift in thinking concerning the utilization of technology, from what will fit into the teacher’s current plan to a mindset of utilizing technology to meet the learner’s needs.

New software allowed teachers to offer educational opportunities through drill-and-skill activities as well as game activities (Murphy et al., 2002). In addition to supplementing instruction, software could also be utilized to introduce new concepts. Murphy et al. (2002) explained that there were four primary uses for software: “to *introduce* new material, to *supplement* regular classroom instruction, to *supplant* or replace direct instruction, and to *make new learning opportunities available* to students through the unique affordances of the software” (p. 11).

Software used for *introductory* learning provided a tutorial on a new concept (Murphy et al., 2002). There was scaffolding available to assist with the learning process. Learning was self-paced and instruction was individualized. Software that provided s*upplementary* learning was utilized for remediation. Much of this software was in a ‘drill and practice’ format. Software that *supplanted* instruction took the place of the teacher’s direct teaching. This type of software was developed to teach an entire course. Software systems that supplant direct instruction may offer an entire roster of courses that students can take for credit via the computer. Finally, *new learning* software enhanced the way teachers taught difficult concepts. This software might assist with the visualization of a concept or provide data with which students could interact.

Computers created a mechanism for a transformation in instruction. Technology had the ability to lead a pedagogical shift toward active learning (Kaput & Thompson, 1994). Giving students access to information allowed teachers to adopt a new type of teaching. Constructivism, or teaching for understanding (Coppola, 2004), fostered student active engagement. Constructivist learning was not discrete; instead, new learning was linked to experiences, settings, and applications.

> Compared with traditional classrooms, constructivist learning environments place more responsibility on students for their own learning. This type of

> responsibility can cause some children to feel frustrated and uncomfortable, particularly if they're accustomed to having a teacher who "transmits knowledge" to them. However, with this added responsibility comes freedom for individual exploration, hands-on practice, and reflection. Typically, when students overcome their initial discomfort, they begin to see the value of constructivist learning. (Sandholtz et al., 1997)

Waxman and Huang (1996) found that moderate use of technology in middle school mathematics classrooms led to a decrease in whole group instruction, an increase in independent work, and an increase in on-task behavior. Worthen, Van Dusen, and Sailor (1994) found a greater level of active engagement in classrooms that utilized integrated learning systems.

The Argument for Change

Technology enthusiasts argued that there were four reasons for the infusion of technology in schools (Peck, Cuban, & Kirkpatrick, 2002). Initially, teaching with technology ensured that all students gained literacy in the area of technology. Technology literate graduates would adapt more easily to the technology changes in the job market. Secondly, technology increased the number of resources in the classroom. The internet, by itself, offered a world of information on any topic and forced students to learn to be critical readers. Additional resources of sound, image, and video files enhanced understanding of concepts and offered media that could be included in presentations. Third, technology could help convert the classroom into a more constructivist environment. Additional resources allowed for more project-based learning and created a learning environment that was more student centered. Finally, technology could be utilized to develop advanced skills in students. These skills could immediately be applied in the job market. Examples included working with networks or troubleshooting computers that needed repair.

Burbules and Callister (2000) argued that the desire to frame the integration of technology into schools as a debate between good and bad must be avoided. They emphasized that a polarization of sides kept individuals from seeing the arguments of the other side and, ultimately, determining a successful way to integrate technology. Bosco (2003) argued that technology is here to stay. While more research is needed, even the most convincing empirical data might not convince those with ideological objections to technology in schools.

Fadel and Lemke (2006) stated that school transformation is part of the technology agenda; however, they did not paint its role as something sinister or negative. They listed three specific roles that technology played. Initially, it offered authentic learning situations for students that are more relevant and rigorous than learning situations in a traditional educational setting. Secondly, they felt that the tools offered by technology and data collection gave new insights into what worked and how educational institutions evaluated their programs. Finally, Fadel and Lemke (2006) felt that “it is an enabling force behind globalization, knowledge work, and entrepreneurship, and thus students must understand the role it plays in transforming political, social, cultural, civic, and economic systems around the world” (p. 3).

Change should only occur after reflection on the implications of the technology and its effect on the learner (Healy, 1999). Collaboration and innovation must accompany each other (Sandholtz et al., 1997). Technology integration served as a symbol for change in schools and allowed teachers the opportunity to experiment with new methods (Sandholtz et al., 1997). Change only occurred when teachers made a choice to try something new in the classroom. For change to be permanent, it had to be part of a systemic change in pedagogy, curriculum, professional development, administration, and educational partnerships (Dede, 1997).

> The indicators for success are not solely dependent on the level of student access, but rather on the nature of student and teacher use and the fidelity of the implementation. Such fidelity of implementation in a school, in turn, is determined by leadership, teacher proficiency, professional development, fit with curriculum, school culture, pedagogical approaches—and to some degree on levels and types of technology access. (Fadel & Lemke, 2006, p. 16)

Barriers to Successful Technology Usage

Cafolla and Knee (1995) argued that there were four barriers that prevented the integration of technology: (a) lack of teacher training, (b) insufficient funding, (c) a mismatch between school needs and available software and hardware, and (d) a general resistance to the change process. Inadequate staff development will be discussed in this section first. Next, inadequate access and technical support will be reviewed. The change process will be covered with an analysis of possible negative effects and an argument that technology represented change in the wrong direction.

Inadequate Staff Development

When computers first entered schools, the focus was on getting the hardware in place (Bosco, 2003). Little thought was given to training teachers to use the hardware or purchasing relevant software to make the computers useful. It was later that educational institutions realized that staff development was key (Becker & Riel, 2000; Hoff, 2005). Teachers who received staff development were more likely to take a constructivist approach to learning (Becker & Riel, 2000). Staff development was also key to ensuring teacher buy-in for the utilization of data to make instructional decisions (Olson, 2007). Teachers were already able to integrate technology at home, and they wanted to learn more about using technology in the school environment (Cuban, 2001).

Staff development was one piece of the implementation process. Once teachers gained familiarity with the technology, there was less fear. As comfort increased, so did teacher utilization (Guhlin, 2001). Once a core group of teachers began the change process with technology, other teachers followed (Sandholtz et al., 1997). Teachers were likely to experience success if they took small steps toward change (Zhao, Pugh, Sheldon, & Byers, 2002). This approach to change reflected an evolutionary strategy over a revolutionary one. However, if the staff development was not sustained, the potential of technology could not be realized (Pierce, 2007).

Teacher attitudes toward integrating technology related directly to their technology abilities (Sandholtz et al., 1997). Teachers who once had a fear of “technology-centered” classrooms described their classrooms as “learner-centered” after they received training. Teachers utilized the computers to give students immediate feedback, individualize instruction, and create a more engaging learning environment. As an additional benefit, teachers saw discipline problems go down and communication with parents increase (Sandholtz et al., 1997).

Unfortunately, an underfunded piece of the technology pie was teacher training (U.S. Department of Education, 2000). Supplying teachers with current hardware and software did not alter instruction. The process of technology integration took years and required changes in instructional practice (Ertmer, 1999). In many instances, the addition of technology gave teachers another way to maintain current teaching practices (Cuban, 2001).

Though the number of computers in the classroom may have increased, the ability of teachers to integrate the new technologies did not grow comparably, and teacher integration still lagged behind hardware acquisition (McKenzie, 2002). Urban and rural teachers received less staff development than suburban teachers and were less likely to use technology (Wenglinsky, 1998). A recommendation was made in 1995 to have 30% of technology budgets devoted to teacher training (Punderson, 2001). When writing educational technology budgets, Marc Tucker, an analyst of classroom computer policies, recommended the following funding distribution: (a) 25% on software, (b) 25% on hardware maintenance, and (c) 50% on teacher training and support (Oppenheimer, 2003). The actual investment in teachers was 6% of the budget ("Dividing the pot," 2005; U.S. Department of Education, 2000). In 2008, only 46% of teachers felt they had the requisite training to integrate technology in the classroom (Downey, 2008).

Sugar (2002) felt that a new position must appear on campuses to assist teachers with integration. This person would assist with technology integration while helping the teacher deal with the resistance to change. Teachers were surveyed and asked how they would use a technology "butler." Their top five responses were: (a) assist with technology integration, (b) develop lessons, (c) create ways to implement technology more efficiently, (d) fix problems that arise, and (e) provide guidance on technical tasks.

Most of these top responses correlated to a need for additional training in technology and its application to the curriculum.

Ertmer (1999) argued that, once the first-order barriers were eliminated (purchasing hardware/software, installation, connectivity issues), the second-order barriers emerged. These dealt specifically with teacher attitudes toward technology: (a) animosity toward change, (b) lack of belief that the technology would be beneficial, (c) resentment of the additional time demands, and (d) concerns that technology might negatively affect the student-teacher relationship.

The Report of the Web-Based Education Commission (U.S. Department of Education, 2000) indicated that schools underinvested in personnel costs. Bond issuance or grants were often used to purchase hardware and software (Snider, 1997). Unfortunately, the personnel costs did not find their way into this funding source and became the ignored piece of total cost of ownership. Absent training and support, the technology went largely unused (U.S. Department of Education, 2000). Without the training, student achievement through the use of technology was unlikely (Hoff, 2005).

The company CDW-G commissioned a study that was conducted in February of 2005 (Ascione, 2005). The survey asked teachers numerous questions about technology as it related to teachers. Concerning staff development, 31% of teachers reported that they had not received any training in the last 12 months. Only 11% reported over 2 days of training in the previous 12 months. The survey paralleled results from 2004 and showed that staff development related to technology was not continuous.

In order to integrate technology, teachers needed to know how the technology would support their curricular goals and teaching practices (Zhao et al., 2002). They needed to understand the abilities of the software, its intended use, and its shortcomings. In addition to this, teachers had to feel a level of support from others who would help them when they reached stumbling blocks. Finally, staff development had to be ongoing and emphasize hands-on applications (Bozeman & Hiatt, 1999). The average teacher requires three to six years of training to achieve integration (Webb, 1999).

Inadequate Access and Technical Support

When computers are located in isolated labs, teachers view the technology as an optional supplement and are less likely to utilize the technology (Sandholtz et al., 1997). Efforts to increase access to computers at the elementary level denied resources to upper grades where the technology may have been more appropriate for learning (Healy, 1999). Lack of access and training kept teachers from integrating technology into instruction. Teachers who were focused on maintaining a computer shifted their focus away from integrating the technology into the instruction (Dede, 1997; Stallard & Cocker, 2001). If a computer broke down, the teacher lost confidence in the resource (Cuban, 2001). If support was not immediate, the teacher may have decided the resource was not worth the time or effort (Wenglinsky, 1998).

A series of studies in 1998 by Becker and Anderson (Herring, 1999) reflected views of 4000 teachers. In the report, teachers indicated a need for technical help at least once a month for successful integration. Two-thirds of the teachers reported that they did not receive it in a timely manner. In another study in 2005 (Ascione, 2005), 64% of teachers indicated they needed more computers in the classroom. In June of 2008, two major teacher unions released a report entitled *Access, Adequacy and Equity in Education Technology*. The report looked at the level of technology access and support in schools (Downey, 2008). While educators felt technology was essential, they complained about outdated equipment and a lack of technical support. Teachers indicated that both these issues impeded technology integration in the classroom. Server crashes and technical malfunctions often caused teachers to resort to Plan B (Peck et al., 2002). When technical issues became routine, technology lessons were abandoned.

The Negative Effects of Increased Investment in Technology

Not everyone thought that technology would benefit the schools. Postman (1997) felt that students naturally acquired technology skills and it was not necessary for schools to provide experiences. Cuban (2001) argued that there was inadequate data collection to prove that technology made education more efficient or, at least, had a positive impact on test scores. Healy (1999) argued that the supportive evidence that did exist had come from studies funded by companies with a vested interest in a positive outcome, thus compromising the findings. Kaput and Thompson (1994) argued that the curriculum was being altered to accommodate the technology.

In 1983 in Broward County, Florida, teachers resented the poor pay increase they received while the district spent $2.1 million on its computer expansion plan (Oppenheimer, 2003). Schwartz (as cited in Oppendheimer, 2003) described 99% of the educational software programs in 1997 as terrible. He lambasted software as not being written by educators or inspired by important educational considerations.

Fadel and Lemke (2006) spelled out specific reasons why technology did not lead to a transformation in education. First, educational reformers overestimated the ability of existing educational structures to adapt to new technologies. Second, schools did not monitor and document their successes. Third, funding for staff development did not keep pace with the changes in technology.

Schwartz and Beichner (1999) felt that the negative impacts of technology in other areas of society made some individuals cynical about technology. Television, for instance, had created a generation of people with short attention spans that required constant visual stimulation. Schwartz felt that technology acted as a magnifier of effects: the ability to do good could be multiplied, but so could the ability to produce negative results.

Technology costs took funds away from other programs (Hetzner, 2005). Hardware needed to be purchased and maintained. Though educational gains may be documented, the gains did not equal gains achieved with similar amounts of money that were invested in tutoring (Wenglinsky, 1998). Computer availability in schools was unrelated to performance (Tirozzi, 2009).

Many innovations and interventions suffered when money was allocated for technology. Creating smaller class sizes was expensive. Raising entry level pay for teachers required resources. Rebuilding old schools required funds. Creating full day pre-schools and kindergartens were extra programs that districts could have started with additional funding. Adding additional art programs to elementary schools, additional foreign language opportunities at the middle schools, and interdisciplinary studies in the high schools could also have been funded (Cuban, 2001, p. 193).

Because funding for computers can divert funds from other programs, Burbules and Callister (2000) argued that technology spending can be detrimental.

> The education market is so large that if even a few states or districts can be persuaded that a particular new technology will take care of their difficulties, millions of dollars can be made on the deal. But because so many problems of education are the result of inadequate resources or the misallocation of resources, funneling more of the finite amount of funding available into one area of spending might actually exacerbate these problems, not remedy them. (p. 8)

Healy (1999) argued that earlier computer use did little to improve student achievement. In a speech in 1997, Samuel Sava (as cited in Healy, 1999), the former head of the National Association of Elementary School Principals, commented on the billions of dollars that had been spent on technology and questioned the impact it had. In fact, Healy (1999) observed that the image of students using computers may seem impressive, but it did not imply that students were learning anything important. Technology had not led to a transformation in the delivery of instruction. Federal dollars had resulted in “islands of innovation, not a sea of change” (U.S. Department of Education, 2008, p. 2).

In 1996, a California task force recommended budgeting $11 billion on computers. The budget-strapped state had seen a decrease in academic performance. The push for computers came above the needs of reducing class size, raising teacher salaries, increasing instructional hours, and improving facilities (Oppenheimer, 2003). San Francisco papers questioned an internet wiring plan when there was no money to install electrical outlets, fix buildings, or hire additional teachers.

Companies that sold educational software took advantage of educational institutions that were hungry for new programs (Noll, 1997). Media specialists, eager to buy something new, did not consider how the new program would integrate into the existing curriculum. In addition, some programs proved to be frustrating or too complicated for the end user. In the end, some of the programs ended up in a storage cabinet (Noll, 1997).

Change in the Wrong Direction

In 1996, as Steve Jobs was leaving his position as president of Apple Computer, he commented, “What’s wrong with education cannot be fixed with technology” (Oppenheimer, 2003, p. 52). Though he had played a great role in getting computers into the schools, he no longer saw them as the change agent he had once thought.

There was also a time factor involved with the integration of technology. Computers can be time wasters (Stoll, 2000). Instead of molding the technology to support the curriculum, the curriculum was altered to justify the integration of technology. Technology may have hindered advancement when it became tangential to the learning content (Means, 2000).

Stoll (2000) asserted that

> Reformers see technology as a back door through which they’ll shake up traditional classrooms. At best, it’s an expensive – if disingenuous – way to reform our schools. At worst, it’s outright fraud: selling a hidden agenda on the promise that technology will improve our schools. (p. 30)

Healy (1999) felt that the “techies,” rather than the educators, now had the power to make educational decisions.

Educational institutions differed from businesses in that they were non-profit and controlled by citizens (Cuban, 2001). Schools were labor intensive institutions that served many purposes, with a primary mission to educate its citizenry and instill the values of the community. Conservative by design, schools were not quick to change. Therefore, the ‘technological revolution’ that had dramatically altered business would not be able to transform a school quite as quickly (Cuban, 2001). Any transformative effect on teaching and learning would take time (Means, 2000). Three decades of use did not initiate a dramatic change in how schools operated or how instruction took place (Ertmer, 1999).

Early stages of technology adoption mirrored the existing school structure. When a school purchased an Integrated Learning System (ILS), the program provided instruction, furnished feedback, and kept track of assessments (Stallard & Cocker, 2001). However, the implementation did not reflect enhanced instruction. Instead, it duplicated the existing classroom. Since the teacher was still in the room, the change could not claim a cost savings.

The normal structure of a high school was not conducive to learning with technology (Stallard & Cocker, 2001). A teacher signed up for the computer lab and took the class there for the entire period. The 20-minute attention span of the student was not taken into account as the class spent the entire 55-minute (or 90-minute) period in the lab. Students lost interest, and activities were not varied.

As the diversity of software grew, the ability to adequately measure its impact became more difficult (Murphy et al., 2002). State assessments and technology-supported learning were not directly aligned, and this made it difficult to measure the effect of the software on learning. The transition into the twenty-first century brought a testing mandate that required educational institutions to measure what was being taught. Technology’s impact on test scores (Cuban, 2001) was hard to measure. Even if new software products offered an innovative aid to instruction, the product would have to correlate to state testing standards (Means, 2000). Learning aspects of a more constructivist classroom, such as creativity or collaboration, required a new type of rubric to show a direct link between technology and student learning (Means, 2000). However, if technology could not be linked to an increase in test scores, result-conscious teachers would stop utilizing the technology.

Added Value and Assessment

Those who fund the schools demand some level of accountability based on academic achievement measured with objective means (Stone, 1999; Webster & Mendro, 1997). Many different forms or measurement exist. There are standardized tests that can be utilized as a pass/fail measure or as an added value determiner. There are also alternatives to the traditional standardized test.

Alternatives to traditional standardized testing have been proposed and tried (Sanders & Horn, 1995). Authentic assessments, such as labs that students need to perform, have been designed and implemented. The first year, this assessment provided good information. However, there were numerous problems. Initially, the cost for an authentic assessment reached five times the cost of a traditional multiple-choice standardized test. Secondly, it was difficult to create future assessments that could be equated to the first assessment. Trouble spots would include the inability to do wide-range field testing. If the original field test was utilized again, there was a great risk of teachers only teaching the assessment question and not the material which the question was meant to assess. One solution to authentic assessment would be to only test a sample of students and base the results for the school on that sample (Sanders & Horn, 1995). However, since this implementation strategy would not yield results for every student, parents would not have yearly data on the progress of their students. Schools could not utilize yearly data to plan interventions for specific students.

The traditional standardized test measured student gain as it related to a norm or a pre-determined standard for achievement (Stone, 1999). However, pass/fail analysis of standardized tests did not take into account the level at which students started. Thus, schools with high levels of disadvantaged students had no way to demonstrate gains except for having more students reach the standard.

Standards-based assessments encouraged poor educational practices (Stone, 1999). Some school leaders felt pressured to label more students as special education and exempt them from the test. It also became practice to focus energy and resources on the lowest-achieving students. Finally, if states lowered standards because of poor results, it encouraged mediocre goals.

Value-added analysis was not used to measure improvement by comparing pass/fail percentages. Value-added data were used to indicate if the student made progress from the previous year. A positive residual value indicated value added beyond the expected growth of the student. This measure allowed students to be compared to themselves. The statistic could be utilized to monitor student growth over time. In aggregate form, the data could help researchers determine the effectiveness of a school, a teacher, or a specific education intervention (Stone, 1999). In conjunction with standards-based data, it can give an excellent picture of a school's accomplishments. Because of the nature of the statistic, sources of bias can be controlled (Hershberg, 2005). Value-added data measure the "school effect" – the influence the school has had on the student's achievement, regardless of the student's socioeconomic status or other factors (Irish & Ager, 2009).

There is no question that biostatistician William Sanders has had a tremendous impact on Tennessee's educational system (Berg, 1998). Berg (1998) described him as "a bad teacher's worst nightmare" (para. 5). Two statisticians that audited Sanders and Horn's (1995) work felt his methods were accurate. A testing expert felt that the data may have helped identify teachers at the extremes, but the large group in the middle could not be evaluated exactly. Sanders and Horn believed that this work should be utilized in conjunction with other data to serve as a diagnostic tool for schools. Irish and Ager (2009) contended that research should continue. In addition, external evaluators should monitor existing systems.

The Dallas Value-Added Accountability System began in 1984 (Webster & Mendro, 1997). When Texas changed its accountability system, the original system was adapted to meet the new requirements. The system utilized a multiple regression model to monitor student growth. Similar to the Sanders and Horn model, the Dallas model accounted for preexisting student differences and prior achievement levels.

Bracey (2000) had problems with the added-value model utilized in Tennessee and developed by biostatistician William Sanders. He did not like the fact that teachers were labeled effective solely on producing higher test scores. He felt testing every child every year in five subjects was a tremendous drain on resources. He did not agree that standardized tests could truly measure high-level thinking skills. Finally, he felt that test-taking ability did not transfer to model a student's general achievement. He also questioned the calculation itself that showed teacher effectiveness ratings varying from year-to-year.

Sanders and Horn (1995) argued that the standardization process for multiple choice tests allowed for the accurate measure of attainment of skills based on set standards. They also argued that current tests could gauge higher order thinking skills. Non-standardized tests could not be generalized over a period and performance assessments only measured a narrow range of skills.

Jesse Rothstein argued that there were flaws in the added value calculation (Viadero, 2009b). The sorting procedure for assigning elementary students in classrooms affected the data. Running an analysis on the effect of fifth grade teachers on student test scores in the third and fourth grade, his falsification test should have shown no correlation. However, he was able to demonstrate large effects while utilizing three different added-value models. He argued that elementary classrooms are not built randomly, and the sorting procedure used by principals tended to skew the data.

Other researchers disputed Rothstein's findings. Koedel and Betts argued that the bias due to student sorting could be minimized by utilizing more years of data from each teacher (Viadero, 2009b). Kane and Staiger (Viadero, 2009b) controlled for the students' prior year setting and found the added value results correctly identified the teachers with a history of higher learning gains.

Haycock (1998) argued that the value added research of Sanders validated the effect of good teaching. She examined the research that related to the performance of low-achieving students in Tennessee. She pointed out that the average gains of the least effective teachers were 14%, while the gains for the most effective teachers were 53%. She noted that the gaps were equally noticeable for groupings of average-achieving students and high-achieving students. Haycock pointed out that similar studies in Dallas mirrored the results in Tennessee.

The added value statistic led to the growth model for accountability purposes (Karhuse, 2009). If a student made significant strides in a school year, that student could be counted as a 'passer' for accountability purposes. This new growth model was accepted for determining Annual Yearly Progress in many states. Texas was allowed to begin utilizing the growth model for its 2009 test results.

Summary of Review of Literature

Given unlimited resources, every student would have a computer. However, expenditures for technology have to come from somewhere. As a result, the debate continues as to whether technology improves student achievement. Many have tried to measure the effects of technology by utilizing standardized tests. Few researchers have been successful in showing a relationship between a particular piece of software and student test results. Absent a strong link between the two, funding for technology will continue to be debated. It remains incumbent upon school district leaders to continue to evaluate the effect of their initiatives, especially those in technology where the total cost of ownership is high.

CHAPTER III

METHODOLOGY

This researcher focused on the possibility that a link existed between the amount of time a student spent on *Destination Math* (usage) and the math residual value (MRV) derived from a student's actual TAKS score compared to the student's predicted TAKS score on the math TAKS test. In order to examine this possibility, three different data sources were used and the information was linked. The three data sources were: (a) the district student database iTCCS, (b) the INOVA predicted score data, and (c) the Usage data from the *Destination Math* software.

This chapter contains information about the Texas Assessment of Knowledge and Skills, the software program *Destination Math*, and the implementation of *Destination Math* in Xcellence ISD. Following this is a description of the population, the instrumentation, and the procedures. The chapter concludes with a section on data analysis.

Texas Assessment of Knowledge and Skills

The state of Texas began its statewide assessment system in 1985. The first test given was the TEAMS test. This was followed by the TABS test. The next set of tests, called TAAS, were developed to increase the rigor of the exam and tie the test to the state curriculum – the Essential Elements. When TAAS was implemented, the state implemented a rating system for schools. At a certain point, many of the schools in the state had achieved Recognized (or better, Distinguished) status. Texas lawmakers decided that the curriculum needed to be more rigorous and the assessment system needed more rigor as well. The state spent years creating a new state-mandated curriculum – the Texas Essential Knowledge and Skills (TEKS).

The new curriculum rolled out before the new testing arrived. Parts of the TAAS test began to become aligned to the more rigorous curriculum. In 2003, the state began its first implementation of its new assessment instrument, the Texas Assessment of Knowledge and Skills (TAKS). Students who were sophomores in 2003 had to pass the more rigorous test in order to graduate. To transition the phase-in of the more rigorous exam, the class of 2005 needed to pass the TAKS test score at a less rigorous standard than the panel recommendation.

School accountability was put on hold in 2003. Most schools were allowed to retain their 2002 state rating for an additional year. The class of 2004 took an eleventh grade TAKS test but it did not count for graduation requirements. This was the last group for which TAAS was the exit test required for graduation.

The class of 2006 had to pass the TAKS Exit Test at a level 1 Standard Error of Measurement below the panel recommendation. This was a higher standard than the one set for the class of 2005 but lower than the panel recommendation. The class of 2007 had to pass the TAKS Exit Test at the panel recommendation. The TAKS Exit Test was given to students in the eleventh grade, unlike the TAAS exit test, which students took in tenth grade. Additionally, high school students took TAKS in the ninth, tenth, and eleventh grades. TAAS was only administered to tenth grade students in high school.

The state of Texas used extensive field testing for all of the items utilized on the TAKS test. Panels of experts were organized to set the passing standards for the test.

Statewide surveys were conducted before the TAKS test was released in order to get teacher input on the types of items that might appear. Teacher input was also sought to determine which of the curriculum elements of the TEKS would be tested with the new TAKS test.

The Software Program *Destination Math*

Riverdeep (2006) was founded in 1995. It advertised itself as one of the fastest growing companies that produced educational software. Its flagship product, *Destination Success*, was comprised of *Destination Math* and *Destination Reading*. Houghton Mifflin Harcourt (HMH, n.d.-a) explained that "*Destination Math* is built on scientifically based research, and has been developed in collaboration with noted author, Dr. Concetta M. Duval, a recognized authority in the field of mathematics education" (para. 1).

The following description was taken from the *Destination Math* website: "A comprehensive K-12 math program, *Destination Math* transforms math instruction and bolsters student understanding through a highly engaging learning environment. Students develop fluency in math reasoning, conceptual understanding, and problem-solving skills" (HMH, n.d.-a, para. 1). The following bullets were also part of the explanation of the benefits of *Destination Math*:

- Comprehensive instruction gives students opportunities to learn something new every day.
- Step-by-step explicit instruction helps students progress and gain problem-solving proficiency.
- Built on sound pedagogical research with input from students and educators.

- Individualization and performance monitoring using assessment and prescription to deliver the right content at the right time.
- Engaging animation and audio support keeps students on task.
- A powerful, easy-to-use teacher tool for conveying complex topics in fresh, new ways.
- Integrates with in-classroom devices for effective whole group instruction.
- 24x7 access with tutorial instruction for extended learning outside the classroom.
- A full Spanish version to reach all students.
- Aligns to state and national standards.
- Proven success in accelerating math achievement at all levels. (HMH, n.d.-a, para. 2)

The website contained information on how *Destination Math* met the requirements of Title I, Part A (improving the academic achievement of the disadvantaged), Title II, Part D (enhancing education through technology), Title III (English language acquisition), and Title IV Part B (twenty-first century community learning centers).

Teachers could use *Destination Math* for presentation, remediation, or individualized instruction. As a presentation tool, teachers could utilize specific units from the software to supplement their own presentations of concepts. The teacher would find a lesson that corresponded to the specific concept that was being taught. Using a projector, the teacher could show a segment where the animated character, Digit, explained the topic.

Teachers could also use *Destination Math* as a tool for remediation. Once the teacher discovered an area where the student required remediation, particular lessons could be added to the student's profile. The teacher could assign lessons, determine an appropriate assessment, and set a deadline for completion in the program.

Destination Math could be used for direct instruction. A student could be assigned a pre-test in a topic area. Based on the results of the pre-test, the program would assign the student a series of lessons and assessments to complete. Teachers could set deadlines for completion. Teachers could use this as a supplement to regular instruction or as a primary method for introducing a concept.

The administrative management page is used to keep track of usage for all students and groups. Student time was divided into time spent on instructional activities and time spent on assessment activities. Usage time by teacher was also calculated, adding up all the time of the students assigned to that teacher. Finally, campus time was calculated by adding up all the time that the program was used on the campus.

SUL classifications were constructed based on the total time a student used *Destination Math*. The SUL categories were Minimal, Low, Medium, and High (see Table 1).

Table 1. Classification of Student Usage Based on Total Time

	Total Hours	
Usage Category	From	To
Minimal	.01	4.96
Low	5.01	9.98
Medium	10.01	19.75
High	20.28	48.73

Calculations were based on 20 instructional weeks. Medium users spent a minimum of 30 minutes a week on the software (on average). High users spent a minimum of 1 hour per week on the software. TUL was based on the usage of the students assigned to that teacher. Categories for Low, Medium, and High TUL were determined for teachers (Appendix A). CUL classifications were determined based on total usage hours for the campus.

Implementation of *Destination Math* in Xcellence ISD

The Urban Systemic Program was the expansion of the Urban Systemic Initiative. It serviced many districts in San Antonio with the primary aim to improve math and science instruction in districts that served students from low socioeconomic backgrounds. In 2003, two of the largest districts in San Antonio were researching *Destination Math* as a supplemental program to assist students. The director of the San Antonio Urban Systemic Program (SAUSP) thought the program would help meet the needs of the member districts. She stated, "*Destination Math* is absolutely on the leading edge of technology and what we knew technology could do for the teacher – but had never seen anyone implement" (HMH, n.d.-b, case study A7432, para. 5). She felt that teachers needed additional resources to help prepare students in mathematics. She was looking for a technology solution that could continue in the schools after the USP program closed.

In 2004, *Destination Math* was purchased by five San Antonio school districts with funding assistance from the San Antonio Urban Systemic Program. The software version, LMS3, contained an English version and a Spanish version of all the lessons. The curriculum ranged from first grade to ninth grade.

Destination Math was implemented in different ways across the Xcellence ISD district. In grades 3-5, the program was mostly utilized as an additional way to present math concepts. Usually, computer lab time would be scheduled for each teacher. Classes would rotate into the lab for a specific lesson. Overall use on campuses varied, based upon the principal’s view of the advantages of the program. Some of the elementary schools had switched from an inclusion model to a rotation model for fifth grade so one teacher in the school taught all of the math students. A few of these fifth grade math teachers used *Destination Math* regularly as a supplement and an assessment tool.

Implementation strategies varied between the middle schools. In 2005-2006, Middle School 2 had problems with the computer lab utilized by the math teachers. However, the reading lab had new computers and the teachers were able to utilize these computers after school. *Destination Math* was utilized for individual instruction after school and for math remediation. As the TAKS test got closer, math teachers were assigned time slots during the school day to take their classes for whole group instruction. Middle School 3 had an excellent computer lab that was used exclusively by the math department. A few teachers used *Destination Math* on a regular basis. Because the school had a variety of software products, *Destination Math* was not used by every teacher during lab time. Middle School 1 had a good computer lab for sixth grade. It was down the hall from the teachers and using the lab was part of the routine for the sixth grade teachers. However, the labs for the seventh and eighth grade classes were old and needed attention. Usage in these grade levels suffered because of the lab conditions. The program was also utilized for summer remediation for middle school. However, the time logged for this purpose was not part of this study.

The high school utilization of *Destination Math* was minimal. High School 1 had a new computer lab. *Destination Math* was utilized on occasion by the Algebra I teachers. Because the teachers had projectors built in their rooms, a few of the Algebra I teachers would use lessons from *Destination Math* as a presentation tool. Because of the way *Destination Math* calculated usage, this usage time was not reflected in the teacher's total usage. High School 2 utilized the program as part of its remediation program for the TAKS test with a select group of eleventh and twelfth grade students to review specific concepts. High School 2 did not utilize *Destination Math* for the Algebra classes, made up of mostly ninth graders.

The district monitored the usage of the program and gave usage reports to the principals. Schools that were not using the program were asked to have teachers utilize it more. In 2005-2006, numerous problems hindered the full implementation of the program. The major problems are listed below.

- Computer labs in many schools had aged and needed attention. Lack of available labs hindered teachers from utilizing the program.
- Moving students between campuses was a problem for the management system. The unique local student ID number could only exist at one campus at a time. If a student moved from Campus A to Campus B, someone with district administrative rights had to change the campus location of the student. Only five people at central office were given these permissions.

Teachers with new students found it frustrating that they could not build an account for a new student without making a phone call first.

- There was not an automatic update of the student information system in *Destination Math*. As a result, the teacher would have to build a data record for new students. This required extra time for the teachers.
- Reports could not be run in alphabetical order. There was a glitch in the sorting program that kept this from happening. As a result, when a teacher ran a report for her class, the names would not be in alphabetical order.
- During the year, the location of the program changed from one server to another. As a result, the HTTP address changed. Shortcuts that had been saved on computers across the district had to be rebuilt. Because most labs were "frozen" from changes (the district was using a program called Deep Freeze), the computers had to be individually "thawed," the shortcut changed, and the computers re-frozen. This process took weeks since there was no mechanism to do this remotely and a technician needed to adjust each computer.

There were additional problems during the 2006-2007 school year. Because that data is not part of this study, these problems will only be discussed briefly.

- Riverdeep introduced its new operating system – LMS4. This system fixed some of the usage problems felt by LMS3. However, LMS4 did not have a functional Spanish version for the first six months. As a result, many teachers wanted to stay with LMS3. It was decided at the district level to offer both programs.

- LMS3 and LMS4 were loaded on the same server. After months of problems with LMS4, it was assumed that the problem may have been related to the fact that both programs resided on the same server. Though the server met the minimum specifications of the company, the server may not have been powerful enough to run two versions of the program. LMS4 would lock up during the day. As a result, a district technology administrator would have to monitor the server on a daily basis.
- It was easier to maintain the student database for LMS3, so teacher rosters were built from the district scheduling data. This allowed a teacher to log in and have all of his classes already built. The LMS4 system was slightly more difficult to update and scheduling data were not loaded. Teachers had to build their classes by selecting students from a school roster that had been imported into the program. This process was not difficult but it did require a little extra time.
- The district had purchased *Destination Reading* for the elementary schools and this was part of LMS4. The student usage data report reflected the total amount of time spent using *Destination Math* and *Destination Reading*. The only way to separate the usage data between the two programs would be to run individual student profiles.

The lessons in *Destination Math* were not written to match the Texas Essential Knowledge and Skills. However, a Riverdeep consultant provided a cross-reference to show which lessons corresponded to different parts of the Texas curriculum requirements. In addition, a Riverdeep representative brought together teachers from different districts to create a set of assessments in the program that would correlate, by grade level, to different objectives on the state TAKS test.

In 2005-2006, the program was not integrated into the Xcellence ISD math curriculum. Therefore, it was the teacher's responsibility to pick and choose lessons for students to utilize. In the summer of 2006, the curriculum writing teams began to integrate the lessons from *Destination Math* as an optional activity throughout the 3-9 curriculum. In the Spring of 2007, with the purchase of the new Learning Village Curriculum Management System, links from *Destination Math* could be integrated directly into the lesson plans for the teacher to use.

Population

The population for this study included every student in Xcellence ISD in grades 3-11 who took the math portion of the TAKS test during the week of April 18-21, 2006. The results of this study could potentially be generalized to other schools that have similar characteristics and utilize *Destination Math*. This was a sample of convenience as it focused on the results in one district and did not utilize a random assignment. There were 6279 students in grades 3-11 in the district on the PEIMS date for data submission (TEA, 2006a). There were 5951 students in grades 3-11 who took the TAKS test in April of 2006, based on the data submitted to the INOVA Center. Not all of these students were introduced to *Destination Math*. A small group could not be matched to their usage time (see Appendix A). Altogether, 3177 students were included in the data analysis for this study. This represented 53% of the tested population. The overall student population in the district was 9653.

Demographic Information on XISD

The Texas Education Agency makes yearly school district data readily available to anyone who is interested. The Academic Excellence Indicator System (AEIS) District Profile is a report that contains state standardized test scores, population demographics, and demographics of the work force. The data are drawn on the last week day in October.

In 2005-2006, Xcellence ISD had 9653 students (TEA, 2006a). Table 2 contains demographic information about the student population for this time period and for 2010 (TEA, 2010). The overall demographics for XISD have not changed in the last four years. The student population at Xcellence ISD was 95.6% Hispanic in 2006 and 95.8% Hispanic in 2010. The Economically Disadvantaged population was 89.9% in 2006 and it was 87.7% in 2010. The Limited English Proficient (LEP) student percentage was 17.5% in 2006 and 15.6% in 2010. Results from this study obtained for the 2006 school year should, therefore, be applicable to the current population of the district. The researcher chose not to select ethnicity as an independent variable since almost 96% of the student population was Hispanic. Economically Disadvantaged and At-Risk were also not considered as independent variables because of the large percentages in these categories. The information concerning Ethnicity, Economically Disadvantaged, and At-Risk were presented to give the reader a description of the student population.

Table 2. Classification of Students in Texas and XISD for the 2005-2006 and 2009-2010 School Years by Ethnicity

	State %	XISD %	
Ethnicity	2005-2006	2005-2006	2009-2010
African American	14.7	1.7	1.1
Hispanic	45.3	95.6	95.8
White	36.5	2.5	2.9
Native American	0.3	0.0	0.0
Asian/Pacific Islander	3.1	0.2	0.2
Economically Disadvantaged	55.6	89.9	87.7
Limited English Proficient (LEP)	15.8	17.5	15.6
At-Risk	48.7	86.6	84.5

Student Grade Levels

Table 3 contains information about the number of students, by grade level, that were included in the study. The percent of the total sample is listed in the column on the right.

Table 3. Number of Students by Grade Level

Grade	Number of Students	Percent of Study Sample
3	630	19.8
4	502	15.8
5	537	16.9
6	514	16.2
7	350	11.0
8	371	11.7
9	179	5.6
10	50	1.6
11	44	1.4
Total	3177	100.0

The largest number of *Destination Math* users of the program attended elementary school. Grades 3, 4, and 5 accounted for 52.5% of the users. The number of *Destination Math* users was relatively high in sixth grade compared to the numbers in seventh and eighth grade, the other middle school grades. After this, the percentage of users by grade, as a percentage of the 3177 included in this study, declined. The data in Table 3 were illustrated in Figure 1.

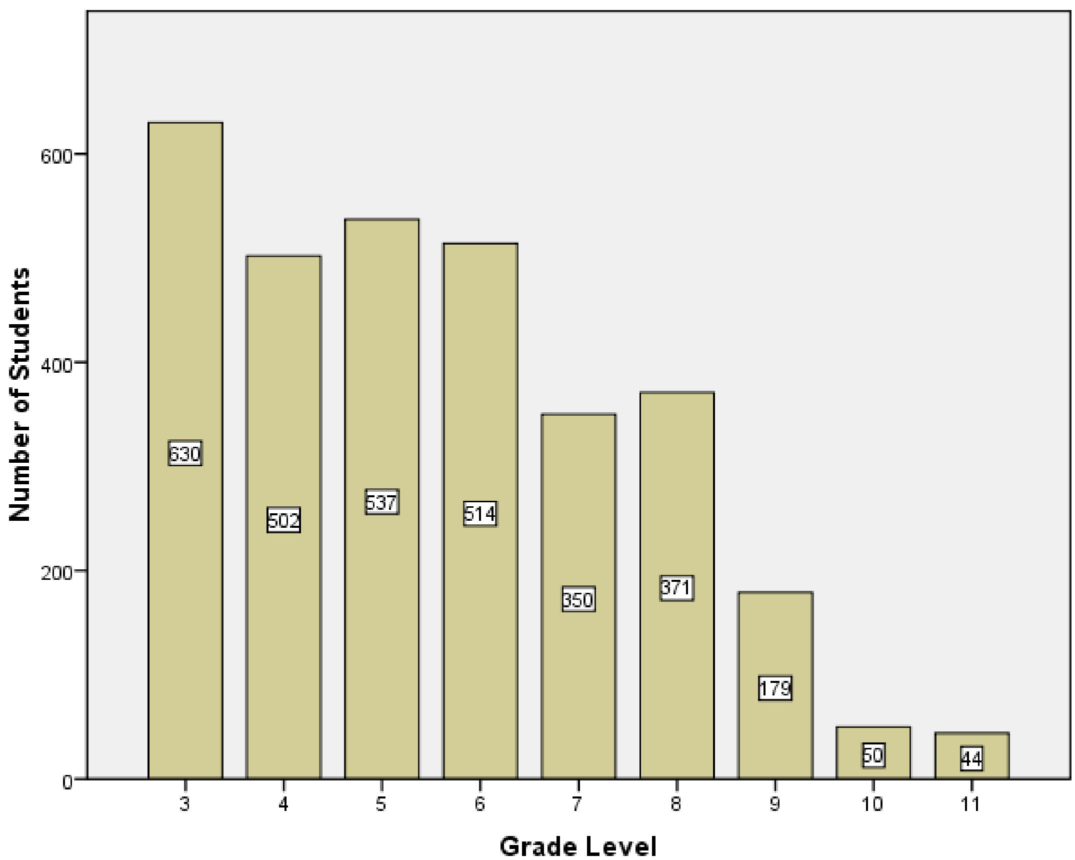

Figure 1. Bar Graph of Number of Students by Grade Level.

The greatest number of users of the *Destination Math* program were in the third grade. Relatively similar numbers of fourth, fifth, and sixth grade students used the program. The number of *Destination Math* users decreased in the seventh grade. There were very few students in the tenth and eleventh grades who used the program.

SUL and Grade Levels

Table 4 contains data relating to a cross tabulation of the number of students per grade level in each of the Student Usage Levels (SULs). Eighty-eight of the High SUL students were in the third grade. There were only 9 other High SUL students. There were no High SUL students in the secondary schools (grades 6-11). Most of the Medium SUL students were in the elementary grades (3-5). There were 3 Medium SUL students in the middle schools and 18 Medium SUL students in the high schools.

Table 4. Student Usage Level by Grade Level

	Grade Level									
SUL	3	4	5	6	7	8	9	10	11	Total
Minimal	260	304	329	447	348	371	167	28	30	2284
Low	205	109	84	64	2	0	11	11	8	494
Medium	77	81	123	3	0	0	1	11	6	302
High	88	8	1	0	0	0	0	0	0	97
Total	630	502	537	514	350	371	179	50	44	3177

TUL and Grade Levels

The cells in Table 5 contain the counts of the number of students in the study who were in a certain grade with a teacher at a certain Teacher Usage Level (TUL). There were 13 cells where the value was zero. Most of these occurred at the secondary level. Therefore, a grade level analysis of the MRV, based on TUL, would not have been appropriate. Because there were no teachers at the middle school or high school in the Medium or High TUL, a comparison of elementary TUL to secondary TUL would not have been appropriate either.

Table 5. Teacher Usage Level by Grade Level

	Grade Level									
TUL	3	4	5	6	7	8	9	10	11	Total
Low	522	445	466	514	350	371	179	50	44	2941
Medium	31	34	71	0	0	0	0	0	0	136
High	77	23	0	0	0	0	0	0	0	100
Total	630	502	537	514	350	371	179	50	44	3177

All of the High TUL teachers taught third or fourth grade. All Medium TUL teachers taught third, fourth, or fifth grade. There were no High TUL or Medium TUL teachers in the secondary schools. As a result of the fact that there were no secondary teachers in the Medium or High TUL, the researcher decided not to create a separate independent variable for elementary versus secondary to look for differences in the mean MRV of each TUL.

CUL and Grade Levels

The cells in Table 6 contain the counts of the number of students in the study who were in a certain grade with a teacher at a certain Campus Usage Level (CUL). There were 12 cells where the value was zero. All of these occurred at the secondary level. Therefore, a grade level analysis of the MRV, based on CUL, would not have been appropriate. Because there were no teachers at the middle school or high school in the Medium or High CUL, a comparison of elementary CUL to secondary CUL would not have been appropriate either.

Table 6. Campus Usage Level by Grade Level

	Grade Level									
CUL	3	4	5	6	7	8	9	10	11	Total
Low	328	221	272	514	350	371	179	50	44	2329
Medium	225	204	198	0	0	0	0	0	0	627
High	77	77	67	0	0	0	0	0	0	221
Total	630	502	537	514	350	371	179	50	44	3177

Instrumentation

The first set of data, the *Destination Math Usage Reports,* came from an HTML document produced by the *Destination Math* software. A set of usage reports were available through the software that allowed district administrators to monitor how much the software was being used and by whom. Three different breakdowns of usage time were extracted from these reports – usage by campus, usage by teacher, and usage by student.

The second data set came from The INOVA Center, Ltd. data that the district had purchased. Pertinent information was extracted from a spreadsheet of district testing data. The statistic of particular importance was the standard deviation of the student's actual TAKS math score from his predicted math score, or the math residual value

(MRV). In addition, the student's state ID and LEP status were extracted from this data set. The state ID was utilized to link the INOVA Center data to the iTCCS data.

The last set of data, *iTCCS Database*, came from the district's data warehouse. This source allowed the researcher to collect information on the student and the student's schedule. The following information was extracted for each student: state ID number, name, math teacher, gender, grade level, campus, and local ID. The information was placed in a data table.

Destination Math Usage Reports

The main data collection instruments were the *Destination Math* usage reports, which are referred to as the Usage Reports from this point forward. These reports came in multiple formats. One report totaled the amount of time that *Destination Math* was used by all the students at each of the district campuses. A second report totaled the usage time of all students assigned to a particular teacher. A third report contained the individual usage time of each student. Instructional time and assessment time were detailed in the usage data report. The data for this study were collected from usage reports for the 2005-2006 school year. The usage data were extracted the week of the TAKS test for math. Different descriptive data related to usage data are given in the tables that follow.

Students logged in hours in two different categories in *Destination Math*: Instructional Time and Assessment Time. Table 7 contains descriptive data on both types of logged time.

Table 7. Statistics for *Destination Math* Hours of Instructional Time, Assessment Time, and Total Time

Time	N	Minimum	Maximum	Mean	SD
Instructional Time	3177	.00	43.90	4.35	6.32
Assessment Time	3177	.00	7.41	.44	1.06
Total Time	3177	.01	48.73	4.80	7.01

Most of the time that students spent with the program occurred at the Instructional Level. This is not surprising for two reasons. Initially, since *Destination Math* can be utilized as an instructional tool, some teachers could have assigned instructional activities that paralleled their lessons without using the assessment tool. Secondly, since assessment results would often lead to an assignment of lessons on the instructional side of the program, hours of Instructional Time would follow naturally from Assessment Time. The average instructional time logged by students was 4.35 hours. The average assessment time logged by students was less than one-half hour.

The mean values for the Instructional Time and the Assessment Time for each SUL are listed in Table 8. In addition, calculations were performed to determine the percentage of instructional time and the percentage of assessment time. The percent columns were calculated by dividing each of the Mean Times by the sum of the Mean Instructional Time and the Mean Assessment Time for the specific SUL.

Table 8. Mean and Percent Values for *Destination Math* Hours of Instructional Time and Assessment Time by Student Usage Level

SUL	Mean Instructional Time	Percent Instructional Time of Total Time	Mean Assessment Time	Percent Assessment Time of Total Time
Minimal	1.64	91.6	.15	8.4
Low	6.51	92.2	.55	7.8
Medium	12.24	89.1	1.50	10.9
High	32.60	90.4	3.46	9.6
Total	4.35	90.8	.44	9.2

The SULs were formed on the basis of the total time. It made sense that the mean instructional time increased with each SUL. While the percent of the Instructional Time of the Total Time was 90.8% overall, the Medium and High SUL fell below this percentage, while the Minimal and Low percentage were above this average. The mean Assessment Time increased with each SUL. As a percent of the group total time, Assessment Time was the highest for the Medium Usage students. Both the High SUL and Medium SUL had percentages of Assessment Time greater than that of the average for the population, 9.2%. It is theorized that students who spent more hours on the program would naturally spend more time with the built-in assessment tools that came with the program.

Table 9 includes three types of time usage: the instructional time usage for each school, the assessment time usage for each school, and the total usage time for each school. Classifications for school usage were based upon natural breaks in the total time data and the enrollment of the school.

All five of the secondary schools were classified with a Low CUL. Only Elementary 3 was classified with a High CUL. At this school, the program was utilized for a Total Time of 6298 hours. The students at Elementary 3 logged 871.55 hours of Assessment Time and 5426.38 hours of Instructional Time. The students at the school with the second largest Total Time logged 3957 hours.

Table 9. School, Use of *Destination Math* for Instructional Time and Assessment Time, Total Time Utilizing *Destination Math*, and Campus Usage Level

School	Instructional Time*	Assessment Time*	Total Time*	CUL
Elementary 1	3852.10	104.98	3957	Medium
Elementary 2	1547.65	96.47	1644	Low
Elementary 3	5426.38	871.55	6298	High
Elementary 4	1355.52	66.98	1423	Low
Elementary 5	872.73	26.28	899	Low
Elementary 6	2870.25	306.07	3176	Medium
Elementary 7	1348.82	282.98	1632	Low
Elementary 8	568.42	57.83	626	Low
Elementary 9	2771.07	107.17	2878	Medium
Elementary 10	1410.72	166.07	1577	Low
Middle School 1	868.83	20.63	889	Low
Middle School 2	660.85	2.97	664	Low
Middle School 3	1314.48	20.52	1335	Low
High School 1	373.08	1.90	375	Low
High School 2	650.52	52.23	703	Low

*In hours.

The INOVA Center, Ltd. – Calculating the Math Residual Value

David Ramirez, the president of The INOVA Center, Ltd., utilized a statistical regression calculation to analyze district TAKS data. Dr. D. Ramirez (personal communication, May 4, 2006) indicated that the statistical equations he used were not unique. He felt his marketable product was the reports he generated with the data. Dr. Ramirez indicated that his statistical calculations aligned with those utilized by Dr. Sanders in Tennessee (Berg, 1998). He utilized these calculations to produce the math residual value (MRV), the dependent variable in this study.

Dr. Ramirez utilized three years of student TAKS data in his calculations. If three years of data were not available, the calculation could still be run, but it was not as accurate. Third graders had no historical TAKS data. The math residual value for third graders was calculated with a different formula that integrated both the math and reading scores from the current year to determine the predicted math score.

Two basic sets of calculations were run. The first utilized a student's TAKS history and current TAKS score to determine an expected score for the student. This score was compared to the student's actual score. The expected score was calculated by creating a matrix of all the scores of the students in the district and plotting a regression line for a specific test and grade level. The student's actual score was compared to the score on this line. The current year score added a greater level of exactness to the prediction (Dr. D. Ramirez, personal communication, 2006).

A student who performed better than expected received a positive residual score (standard deviation from the mean). A residual between .50 and .99 was labeled "slightly tail right." A residual that had a value of 1 or greater was labeled as "tail right." These students performed better than their statistical prediction. A positive residual value indicated that value was added to the student. Because the residual score was based on a predicted value, a student could fail the TAKS tests and still have a positive residual score.

Similar labels were utilized for students who underperformed. These students were labeled "slightly tail left" and "tail left," based on their negative distance from the mean. In other words, students who had a residual between -.50 and -.99 were *slightly tail left* while students with a residual less than or equal to -1 were *tail left*.

The dependent variable of this study was calculated by The INOVA Center, Ltd. The measure was called the "math residual value" or MRV. The calculation for the MRV utilized current and historical data of the student and the district to predict the student's TAKS score. The MRV was determined by comparing the current score to the predicted value. A zero MRV indicated that the student performed exactly as expected. A positive MRV indicated that the student outperformed a statistically predicted score. A negative MRV indicated that the student underperformed, compared to a statistically predicted score.

The predicted score took into account the performance of students across the district. Therefore, if a student's improvement was less than the improvement of the district, the student might earn a negative MRV. Any intervention strategy had to improve the student's score beyond the overall improvement of the district to produce a positive MRV. Thus, the MRV served the function of a control group, comparing a student's score to the expected score. Students who had no contact with *Destination Math* were not included in this study.

iTCCS Database

Districts warehouse their student data either with an internal system or an external system. Xcellence ISD utilized the Region 20 Educational Service Center iTCCS system to house all of its student data. The Service Center stored the district's data in a number of tables. Data in these tables were linked to other data sources using common data fields. For most student-related data, the common field was a unique local ID number.

Procedures

Microsoft Access and Excel were utilized to create the databases necessary for this study. A database was constructed from the sources listed in the instrumentation section. The database contained the following data:

1. A randomly assigned student number
2. The TUL classification for the math teacher of the student
3. The math residual value (MRV) of the student
4. The LEP status of the student
5. The grade level of the student for 2005-2006
6. The gender of the student
7. The CUL classification of the campus of the student
8. The number of hours the student utilized the *Destination Math* program — instructional time, evaluation time, and total time

9. The SUL classification of the student

Most of the explanations for the creation of the databases and the conversion charts for usage classification are explained in Appendix A. A summary of the procedure appears here. The usage reports from *Destination Math* were converted into spreadsheets. Then, the time was converted from a text entry to a numeric field. The usage data were converted into a database and the current format, ‘x hours, y minutes’ was converted to a number of hours, rounded to the hundredths. In the usage report that contained the student usage, the student names had to be matched to names in the iTCCS database. The data set did not contain the student’s ID number – only the student’s name. Therefore, time consuming measures had to be taken to associate the student’s name with his unique student ID.

Matching names between the iTCCS database and the *Destination Math* spreadsheet posed many problems. Since the original *Destination Math* data were built from the iTCCS database, a majority of the names matched up. Multiple students with the same name in iTCCS could potentially be paired with the same set of usage data. As a result, many of the students had to be carefully paired, based on grade level, campus, and math teacher to avoid this problem.

The Student Usage table in *Destination Math* posed an additional challenge. A spacing hyphen appeared between the parts of the name. Before the names could be paired with the corresponding names in the iTCCS database, the hyphens had to be removed. As a result of removing the spacing hyphens, all those students with hyphenated names lost the hyphens. These students had to be paired individually with their names in the iTCCS database. The state ID was utilized to include the data from The Inova Center, Ltd.

The resulting database was scanned for duplicate names. Numerous steps were utilized to combine data where multiple entries appeared for the same student. In final preparation of the table, a randomization procedure was utilized. Each student was assigned a new number, 1 to N. The columns for local student ID, state ID and name were deleted.

The following steps were utilized to create the database.

Step 1: Create the Usage files; convert from HTML to Excel; remove hyphens

Step 2: Utilize a conversion program to create a numeric value for time and copy the numeric values for time over the text values for time

Step 3: Classify student use; delete rows that cannot be used

Step 4: Eliminate grade levels that are not in the study

Step 5: Construct an Access database with the necessary student scheduling information and population data

Step 6: Create a database from the INOVA data

Step 7: Create a database of the usage data

Step 8: Create a data table of all math teachers for every student

Step 9: Match up as many students as possible in the Usage database to students in the iTCCS database in order to get a local ID and a state ID

Step 10: Discover the state ID and the local ID for as many of the remaining students as possible

Step 11: Combine the times of students with multiple entries into one total entry

Step 12: Import usage data back into Access and match it with the appropriate demographic data and MRV data

Step 13: Recode data before exporting to SPSS

Appendix A contains illustrations and a more detailed explanation of each step described above.

Data Analysis

SPSS was utilized for data analysis. The Explore procedure was utilized to look at the distribution of the data set. The GLM Univariate procedure was utilized to run the homogeneity of variances tests and descriptive statistics, ANOVA tests for differences in means and to calculate effect size and power. Crosstabs were calculated to examine cell frequencies for gender, grade, LEP status, and usage subgroup classifications.

The data from the study were analyzed using tests for homogeneity of variances, ANOVAs, t-tests, and descriptive statistics as outlined in *Educational Research: An Introduction* (Gall, Borg, & Gall, 1996). The dependent variable was the math residual value (MRV) statistic. ANOVAs were performed for each of the independent variables described below:

Independent Variables

- LEP Status - LEP students/non-LEP students
- Gender – Male/Female
- Student Usage Level (SUL) – Minimal/Low/Medium/High
- Teacher Usage Level (TUL) – Low/Medium/High
- Campus Usage Level (CUL) – Low/Medium/High

Dependent Variable

- Mathematical Residual Value (MRV)

Multiple data sources were utilized to create the data table that was imported into SPSS. The final dataset was analyzed in Chapter IV.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to determine if students who spent different amounts of time on *Destination Math* exhibited different math residual values. The results obtained from the data are presented in three sections. Initially, the demographic information for Xcellence ISD (XISD) was reviewed. Next, descriptive statistics for MRV and Total Time are presented for the study population. Finally, each of the individual research questions is addressed. An *A Priori* contrast appears at the end of Research Question 4. The contrast was formulated to compare the mean MRVs of students for the combined Minimal and Low Student Usage Levels (SULs) to the combined levels of Medium and High SULs.

There were 3177 students who emerged as part of the study after the database was created. Appendix A contains the rationale why some usage records (n=288) could not be included in the study. The dependent variable in the analyses was math residual value (MRV).

There were five independent variables included in this study. The first independent variable was Student Usage Level (SUL). Students were assigned a SUL based on the total time on the program. This was included to determine if the means of the MRVs for SULs differed based on the total time the student used the program. The second independent variable was Teacher Usage Level (TUL). This was included to determine if the means of the MRVs of the students in each TUL differed. The third independent variable was Campus Usage Level (CUL). CUL was included to determine if students at campuses that had higher usage of the program had average MRVs that differed from students at schools that did not have as much program usage. The fourth independent variable was LEP status. The researcher sought to determine if there were differences in the mean MRV based on LEP status. The last independent variable was gender. The researcher sought to determine if there were differences in the mean MRV based on gender.

Crosstabs were utilized to examine the possible factorial models. After reviewing a crosstabs of the five independent variables, the researcher found 75 cells with zero students. Therefore, cell sizes were not adequate to analyze the five-way combination. The researcher then pursued the four factorial models. The results of the crosstabs for the five factorial model and the four factorial models appear in Table 10.

Table 10. Listing of Five Factor and Four Factor Factorial Designs and the Number of Blank Cells

Factorial	Number of Blank Cells	Number of Cells
SUL*CUL*TUL*LEP*Gender	75	144
CUL*SUL*LEP*Gender	6	48
TUL*SUL*LEP*Gender	13	48
CUL*TUL*LEP*Gender	9	36
CUL*TUL*SUL*Gender	13	72
CUL*TUL*SUL*LEP	32	72

The highest level factorial that had adequate cell sizes was a three-factor factorial having dimensionality of 4x2x2. The independent variables were SUL, LEP Status, and Gender. A three-way ANOVA was performed to determine if there were any significant interactions between SUL, LEP status, and Gender. The main effects of SUL, LEP Status, and Gender were examined. The independent variables TUL and CUL were examined with separate ANOVAs in Research Question 2 and Research Question 3, respectively. The analyses in Research Question 1 focused on SUL. The analyses concerning SUL appear in Research Question 4 with the data from the three-way ANOVA.

Overview of the MRV and Total Time

The Mean and Standard Deviation were calculated for the Math Residual Value (MRV) and the Total Time to describe the dataset of the 3177 students. The results appear in Table 11.

Table 11. Mean, Standard Deviation, and N for the Math Residual Value and Total Time

Statistics	Mean	SD	N
MRV	-0.01	.99	3177
Total Time	4.80	7.01	3177

Because of the way the MRV is calculated on a district level, the population of students in a school district should have a mean of zero. The students examined in this study had a grand mean MRV of -.01. Therefore, the study sample reflected the population mean. Positive MRVs would indicate value added. The statistical calculations in the research questions were important to determine if positive MRVs were significant or due to chance.

Research Question 1

Do students who exhibit different utilization of *Destination Math* exhibit different math residual values among Student Usage Levels (SULs) of students in grades 3 through 11 in Xcellence Independent School District?

The researcher was interested in the number of students in each SUL. Table 12 contains three columns: (a) SUL, (b) number of students, and (c) percent of the usage group related to the total sample.

Table 12. Number and Percent of Students by Student Usage Level

SUL	Number of Students	Percent
Minimal (0-4.9 hrs.)	2284	71.9
Low (5-9.9 hrs.)	494	15.5
Medium (10-19.9 hrs.)	302	9.5
High (20+ hrs.)	97	3.1
Total	3177	100.0

Students who had profiles on the system with minimal use of the program equaled 71.9% of the population. Only 12.6% had Medium or High SUL. It was theorized by this researcher that, if increased usage led to greater math performance, the mean MRV for this 12.6% would be different from the mean MRV of the remaining 87.4% of the students in the study. Therefore, an *A priori* contrast was conducted. The main effect for SUL was part of the three-factor factorial in Research Question 4. The results of the *A priori* contrast appear with the analysis of the SUL main effects in Research Question 4.

The mean usage time, the number of students (N), the standard deviation, the minimum value, and the maximum value for each SUL classification appear in Table 13.

Table 13. Statistics Based on the Number of Hours of Usage of *Destination Math* by Student Usage Level

SUL	Mean	SD	Minimum	Maximum
Minimal	1.80	1.16	.01	4.96
Low	7.07	1.44	5.01	9.98
Medium	13.74	2.71	10.01	19.75
High	36.06	8.98	20.28	48.73
Total	4.80	7.01	.01	48.73

Students in the Minimal SUL used the program less than 5 hours. Low SUL students logged between 5 and 10 hours. Medium SUL students logged more than 10 hours but less than 20 hours. High SUL students logged more than 20 hours.

Only 97 students were in the High SUL. Most of the students who were introduced to the product were in the Minimal SUL. The number of students in the Medium SUL was 302. The minimum and maximum values correspond to the values used to define each SUL.

Table 14 contains descriptive statistics about the SULs. The mean, N, and standard deviation are listed for each of the SULs.

Table 14. Student Usage Level by Means of the MRV, Number of Students, and Standard Deviation

	Mean of MRV	N	SD
Minimal	-.03	2284	.99
Low	.04	494	.95
Medium	.11	302	1.04
High	-.15	97	.99
Total	-0.01	3177	.99

The two most extreme means were for Medium Users and High Users. The mean of the MRV for all students in the Medium SUL was .11. The mean of the MRV for all of the students in the High SUL was -.15. The data for the SUL Main Effect and interactions are examined in Research Question 4. It reveals that these two groups were different. A positive MRV for the Medium SUL indicated a gain in math performance. However, the effect size of .003 minimizes the importance of this gain.

Research Question 2

Do teachers of students who exhibit different utilization of *Destination Math* have students who differ in average math residual values among all students in grades 3 through 11 in Xcellence Independent School District?

The researcher, through Research Question 2, sought to discover if there were differences in the average MRV among the students of the teachers in each TUL. Table 15 contains information about the teachers who had students with usage time. The elementary schools in XISD were relatively close to each other in student population. Therefore, a similar number of teachers would be expected to use the software at each school. Because the middle schools were also comparable in student population, the same reasoning would apply for middle schools. High School 1 had three times the student population of High School 2. Table 15 contains information about the number of teachers per school who utilized the *Destination Math* program.

Table 15. Number of Teachers Utilizing *Destination Math* Sorted by School

School	Number of Teachers
Elementary 1	24
Elementary 2	14
Elementary 3	27
Elementary 4	22
Elementary 5	21
Elementary 6	21
Elementary 7	22
Elementary 8	12
Elementary 9	29
Elementary 10	22
Middle School 1	6
Middle School 2	3
Middle School 3	7
High School 1	5
High School 2	3
Total	238

Elementary schools had a greater number of teachers who utilized the software. With the exception of fifth grade, elementary classes in XISD were self-contained and one teacher taught all subjects. Therefore, all of the teachers in grades 3 and 4 taught math. In the secondary schools, the program was utilized by the math teachers. In the high schools in particular, most of the teachers who utilized *Destination Math* taught ninth grade. Two math teachers used *Destination Math* for remediation at other grade levels.

Table 16 contains information about the number of students sorted by TUL. Teachers were classified as Low, Medium, or High, based on the total number of hours *Destination Math* was used by their students.

Table 16. The Number and Percent of Students Sorted by Teacher Usage Levels

Teacher Usage Level (TUL)	Number of Students	Percent
Low	2940	92.5
Medium	136	4.3
High	101	3.2

Of the teachers rated as high users, only 3.2% of the students in this study were in their classes. The TUL data were obtained from a separate data table in the *Destination Math* usage reports. Most of the students, 92.5%, were in a class with a teacher who was classified with a Low TUL. This is similar to the results in Table 4, where 87.4% of the students were at the Minimal or Low SUL.

Table 17 contains descriptive statistics for the three TULs – Low, Medium and High. Students in the Low and High TUL exhibited a negative mean MRV. Students in the Medium TUL exhibited a positive mean MRV. The mean for the Medium TUL falls outside the 95% Confidence Interval of the Low TUL. This indicates a potential difference between these two usage levels.

Table 17. Math Residual Value Mean, Standard Deviation, and Confidence Interval for the Teacher Usage Levels

					95% Confidence Interval for Mean			
TUL	N	Mean	SD	Std. Error	Lower Bound	Upper Bound	Min	Max
Low	2941	-.011	.990	.018	-.047	.024	-3.009	5.173
Medium	136	.101	1.067	.091	-.079	.282	-2.080	3.244
High	100	-.046	.976	.098	-.240	.147	-3.620	2.450
Total	3177	-.008	.992	.018	-.042	.027	-3.620	5.173

Since TUL was not an independent variable in the three factor factorial used in this study, a separate one-way ANOVA was conducted. Initially, the test for homogeneity of variances was conducted to determine if the variances for the TULs were homogeneous. A null hypothesis of equal variances was tested. A summary of the results appear in Table 18.

Table 18. Summary of Test of Homogeneity of Variances for Teacher Usage Level

Levene Statistic	df1	df2	p
.760	2	3174	.468

The significance level of .468 does not meet the $p \leq .05$ benchmark needed for rejection and therefore the null hypothesis that the variances are homogeneous was accepted. Therefore, an ANOVA was performed on the TULs. A summary of the results appear in Table 19.

Table 19. Summary ANOVA for Teacher Usage Levels

Source	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta^2	Observed Power
TUL	1.809	2	.904	.918	.400	.001	.210
Error	3128.923	3174	.986				
Corrected Total	3130.732	3176					

The F ratio was less than 1. The probability that the TULs are from the same population is .4 and does not meet the benchmark of $p \leq .05$. Therefore, the null hypothesis that the groups are the same was not rejected. There is no significant difference between the means of the three groups. Therefore, those groups were judged to be equal. The effect size of .001 and the power of .210 both support the decision that the null hypothesis should not be rejected.

Research Question 3

Do students at campuses who exhibit different utilization of *Destination Math* exhibit different average math residual values among all students in grades 3 through 11 in Xcellence Independent School District?

The researcher, through Research Question 3, sought to discover if there was a difference in the mean MRVs of the students that were included in each Campus Usage Level (CUL). The 3177 students in the study were divided into classifications based on CUL. Table 20 is the classification of the number of students who attended campuses of each CUL. Most of the students who were included in the study attended schools with a Low CUL. Only 7% of the students in the study attended a school with a High CUL. The data on the students by CUL were analyzed in Research Question 3 to determine if the average MRV of the students at each CUL was different.

Table 20. The Number of Students Located at Campuses for Each Campus Usage Level

CUL	Number of Students	Percent
Low	2329	73.3
Medium	627	19.7
High	221	7.0

Descriptive statistics for each CUL classification are given in Table 21. Students in the Low and High CUL exhibited negative MRVs. Students in the Medium CUL exhibited a positive MRV. This follows the same pattern as the data in Table 14, which dealt with SUL and Table 17, which dealt with TUL.

Table 21. Math Residual Value Mean, Standard Deviation, and Confidence Interval for the Campus Usage Levels

					95% Confidence Interval for Mean			
CUL	N	Mean	SD	Std. Error	Lower Bound	Upper Bound	Min	Max
Low	2329	-.006	.989	.020	-.457	.035	-3.010	5.173
Medium	627	.001	1.017	.041	-.079	.081	-2.515	3.320
High	221	-.055	.965	.065	-.183	.073	-3.620	3.739
Total	3177	-.008	.993	.018	-.042	.027	-3.620	5.173

Since CUL was not an independent variable in the higher factorial, a separate one-way ANOVA was conducted. Initially, the test for homogeneity of variances was run to determine if the variance for the three classifications was homogeneous. A null hypothesis of equal variances was tested. The results appear in Table 22.

Table 22. Summary of Test of Homogeneity of Variances for Campus Usage Level

Levene Statistic	df1	df2	p
.738	2	3174	.478

The significance level of .478 does not meet the $p \leq .05$ benchmark needed for rejection and the null hypothesis that the variances are homogeneous was accepted.

Therefore, the researcher conducted an ANOVA to determine if there was a significant difference between the MRV means of the three CULs. A summary of the results appears in Table 23.

Table 23. Summary ANOVA for Campus Usage Level

Source	Sum of Squares	df	Mean Square	F	p	Partial Eta^2	Observed Power
CUL	.551	2	.275	.279	.756	.000	.094
Error	3130.181	3174	.986				

The F ratio obtained in the ANOVA has a probability level of .756. There was no significant difference between the means of the three groups. The null hypothesis that the groups are the same was not rejected. The effect size was .000. The power was .094. These are additional reasons that the null hypothesis should not be rejected.

Research Question 4

Do students classified by SUL, LEP status, and Gender exhibit different average math residual values (MRVs) among all students in grades 3 through 11 in Xcellence Independent School District?

In Research Question 4, the researcher sought to determine if students exhibit different average MRVs when using the three independent variables of SUL, LEP Status, and Gender. The researcher chose SUL for two reasons. Initially, the researcher felt that, since LEP Status and Gender were particular to each student, the SUL, which was also particular to the student, should be the usage level that was examined with these two independent variables. Secondly, the use of any combination of SUL, TUL, and CUL was ruled out in crosstabs.

Student Classification – Gender

Table 24 contains data concerning the classification of students in the study by gender. The second column contains the number of students for each gender. The last column contains the percentage of each gender as a part of the 3177 students in the study.

Table 24. Number and Percentage of Students by Gender

Gender	Number of Students	Percentage
Female	1575	49.6
Male	1602	50.4
Total	3177	100.0

There was almost an even split among male and female users of the product. The AEIS Report did not include a classification by gender so it is assumed that the data are in line with gender percentages on a district level.

In the analysis for Research Question 4, the interaction of Gender and SUL was examined. The crosstabs in Table 25 were obtained to examine the distribution of students by gender within different SULs.

Table 25. Gender by Student Usage Level

	Student Usage Level							
Gender	Min	Min %	Low	Low %	Med	Med %	High	High %
Female	1150	73.0	238	15.1	141	9.0	46	2.9
Male	1134	70.8	256	16.0	161	10.0	51	3.2

There is a slightly larger percentage of females in the Minimal SUL. The percentages of Males in the Low, Medium, and High SULs were slightly larger than the percentages for Females.

Student Classification – LEP Status

Table 26 contains the number of students in the three LEP Status labels: (a) Non LEP, (b) LEP, and (c) LEP Monitoring.

Table 26. Number and Percent of Students by LEP Status

LEP Status	Number of Students	Percent
Non LEP	2569	80.9
LEP	411	12.9
LEP–Monitoring	197	6.2
LEP + LEP–Monitoring	608	19.1

The 2006 district AEIS Report contained data that 17.5% of the students were classified as LEP. It is unclear if this number included those students who were in the LEP – Monitoring status (explanation in Chapter III). Because *Destination Math* has a Spanish version of all its lessons, the data for the LEP population were examined to determine if there was a difference in the average MRV for different usage classifications for LEP students. Of the students examined in this study, 80.9% were classified as Non LEP (Limited English Proficiency), 12.9% were classified as LEP, and 6.2% were classified as LEP Monitoring.

For the purpose of this analysis, the categories of LEP and LEP Monitoring were combined. The rationale for this decision was covered in Chapter III. Since these groups are combined for state ratings, it was natural to group them here also. This procedure is also supported by the research of Hopstock (2003).

Table 27 is a crosstabs of LEP status by SUL. Percentages of each cell were calculated by dividing the NonLEP entries by 2569 (Table 26) and the LEP entries by 608. The LEP students had a greater percentage in the Low, Medium, and High SUL groups.

Table 27. LEP Status by Student Usage Level

	Student Usage Level							
LEP	Minimal	Min %	Low	Low %	Medium	Med %	High	High %
Non LEP	1880	73	391	15	230	9	68	3
LEP	404	66	103	17	72	12	29	5

LEP Status, Gender, and SUL

Table 28 is the crosstabs of LEP status by Gender by SUL. This table was needed to make sure there were no cells with zero entries.

Table 28. LEP Status by Gender by Student Usage Level

		SUL			
		Minimal	Low	Medium	High
Non LEP	Female	952	189	113	30
	Male	928	202	117	38
LEP	Female	198	49	28	16
	Male	206	54	44	13

There were no empty cells in the crosstabs. The smallest n for a cell was 13 for Male-LEP-High SUL.

Table 29 contains descriptive data concerning the factors that were crossed in the three-way ANOVA. The counts (N) for the classifications for each independent variable are given.

Table 29. Counts and Value Labels for Student Usage Level, LEP Status, and Gender

	Value Label	N
SUL	Minimal	2284
	Low	494
	Medium	302
	High	97
Gender	Female	1575
	Male	1602
LEP	Non LEP	2569
	LEP	608

A test was run for homogeneity. It was a check to see if the variances were alike. The test of Homogeneity of Variances is presented in Table 30. Since the probability value of .239 is greater than .05, the assumption of homogeneity is upheld. Therefore, the Mean Square Within (MSW) calculated for the error term in the three-way ANOVA is legitimate.

Table 30. Summary of Test of Homogeneity of Variances for the Three Factorial ANOVA

Levene Statistic	df1	df2	p
1.233	15	3161	.239

Table 31 contains a summary of the results of the three-way ANOVA that was utilized to check for main effects and interactions. The p value for the three-way interaction was .159. Therefore, the null hypothesis was not rejected and there was no significant interaction between the three factors. The p value for the two-way interaction between LEP and Gender was .651. Therefore, the null hypothesis was not rejected and there was no significant interaction between these two factors. The p value for the two-way interaction between LEP and SUL was .599, and the null hypothesis was not rejected. The p value for the two-way interaction between Gender and SUL was .344 and the null hypothesis was not rejected. Since there is no significant three-way interaction or two-way interaction, the main effects can be discussed.

Table 31. Summary ANOVA for Test of Between-Subjects Effects for Student Usage Level, LEP Status, and Gender

Source	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta^2	Power
SUL	10.639	3	3.546	3.614	.013	.003	.797
LEP	.255	1	.255	.260	.610	.000	.080
Gender	.809	1	.809	.825	.364	.000	.148
LEP * Gender	.201	1	.201	.204	.651	.000	.074
LEP * SUL	1.840	3	.613	.625	.599	.001	.182
Gender * SUL	3.263	3	1.088	1.108	.344	.001	.302
LEP * Gender * SUL	5.093	3	1.698	1.730	.159	.002	.455
MSW	3101.703	3161	.981				

*LEP*SUL Interaction*

There was no significant interaction between LEP Status and SUL. The descriptive statistics appear in Table 32. The pattern for the means for LEP and nonLEP students was the same: Minimal was negative, Low was positive, Medium was positive, and High was negative. The largest difference occurred between the Medium and High SULs for LEP students.

Table 32. Math Residual Value Mean for LEP Status*Student Usage Level

LEP Status	SUL	Mean	N
Non LEP	Minimal	-.02	1880
	Low	.03	391
	Medium	.11	230
	High	-.08	68
LEP	Minimal	-.07	404
	Low	.09	103
	Medium	.12	72
	High	-.32	29

*Gender*SUL Interaction*

There was no significant interaction between Gender and SUL. The descriptive statistics appear in Table 33. Males had negative mean MRVs in the Minimal, Low, and High SUL. Females had negative mean MRVs in the High SUL only. The largest difference occurred between the Medium and High SULs for Females.

Table 33. Math Residual Value Mean for Gender*Student Usage Level

Gender	SUL	Mean	N
Male	Minimal	-.09	1134
	Low	-.02	256
	Medium	.08	161
	High	-.07	51
Female	Minimal	.03	1150
	Low	.11	238
	Medium	.15	141
	High	-.24	46

Main Effects

There was no significant interaction between the three factors of LEP Status, Gender, and SUL. There was no significant interaction with any pair of the factors. Therefore, the main effects of LEP Status, Gender, and SUL were examined.

There was no significant effect of LEP Status. The p value was .610 and was greater than the $p \leq .05$ criteria. There was no significant effect for Gender. The p value was .364 and this was greater than the $p \leq .05$ criteria. Had there been a main effect for either LEP Status or Gender, the result would have given information about student performance in general for these classifications.

There was a difference between the four SUL groups. The F-ratio of 3.614 had a probability value of .013. Since this is less than .05, this would count as one benchmark level to suggest that a post hoc test should be run. Spatz (2001) indicated that a small effect size for an F-ratio is .10. Since the effect size was .003, the effect was very small. The power was .797 which when rounded is equal to the minimum power of .80. Since two out of three benchmark levels were met, the researcher decided to run a post hoc test to determine where the significant difference existed between individual SUL groups.

The Ryan-Einot-Gabriel-Welsh F post hoc test was utilized by the researcher as the post hoc to probe the significant difference in SUL. The results appear in Table 34.

Table 34. Summary of REGWF Post Hoc Test for Student Usage Level

		Subset	
Student Usage	N	1	2
High	97	-.15	
Minimal	2284	-.03	
Low	494	.04	.04
Medium	302		.11
p		.15	.57

Note. The error term is Mean Square(Error) = .981.

The means for the groups in the homogeneous subsets are displayed. Based on the groupings, the Medium Student Usage group is not classified as homogeneous with the High Usage group or the Minimal Usage group.

A Priori Contrast

The researcher theorized that students who utilized *Destination Math* at High or Medium levels would have different MRVs than students who used the program at Minimal or Low levels. Longer interaction with the software should be associated with better MRVs. Therefore, Minimal combined with Low compared to Medium combined with High was explored. Table 35 contains data on the means of the MRVs for the compared groups and Table 36 contains the results of a t-test performed on the two groups.

Table 35. Means for the MRV for Combined Minimal + Low Student Usage Level Compared to Combined Medium + High Student Usage Level

Group	N	Mean	SD	Std. Error Mean
Minimal + Low	2778.00	-0.02	0.99	0.02
Medium + High	399.00	0.05	1.03	0.05

Table 36. Summary of t-Test Comparison of Minimal + Low Student Usage Level to Medium + High Student Usage Level

					95% Confidence Interval of the Difference	
t	df	p (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
-1.19	3175.00	0.23	-0.06	0.05	-0.17	0.04

The significance of the t-test is p=.23. Since p is greater than .05, the null hypothesis that the groups are the same is not rejected.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This chapter contains an overview of the study in the context of the research theory. Following that is an analysis of the results and the factors that accounted for the effect. Next are the conclusions from the findings. The next section contains recommendations for the application of the study, recommendations to improve the study, and recommendations for future research. This chapter ends with a brief summary.

Overview of the Study

Districts must continue to evaluate software in the context of their own populations (Bosco, 2003; National Mathematics Advisory Panel, 2008; Yan & Slagle, 2011). *Destination Math* was a software program that was purchased by the leadership in Xcellence ISD (XISD), a school district in Texas with a student population of approximately 9500. The original intent of the *Destination Math* software in XISD was to assist with fifth grade math and to offer a supplement for teachers to use for math instruction. There was not a specific mechanism identified to determine if the objective was met. The purpose of this study was to determine if the implementation of *Destination Math* in Xcellence ISD had a significant positive effect on residual math TAKS scores.

There are different applications for this study. The results of this study would help XISD district leaders determine a utilization plan for the program in the district. The results could potentially help other school districts determine a proper implementation plan for *Destination Math* or guide the decision-making process for the purchase of this product. The recommendations for evaluating the effectiveness of *Destination Math* can also be applied to other software products where improving math performance is the purpose of the expense.

This researcher chose to examine the effect of *Destination Math* on math performance by using an added value statistic which is a transformed math TAKS score. This statistic, labeled the math residual value (MRV), allowed the researcher to focus on a student's growth and not on the student's raw score or scaled score. The MRV in the study represented value-added data. Value-added assessment could be utilized to measure the effectiveness of an intervention (Stone, 1999). A piece of software improved math performance when an increase in scores occurred with software use (Bosco, 2003). This researcher used the MRV to measure the math performance of individual students as it related to other students in the district. While a positive MRV of any size would indicate positive growth, statistical analysis was still required to determine if that growth was significant or due to chance.

This researcher used a large sample (n=3177), examined only the effect of *Destination Math*, and utilized an added value statistic to measure residual math performance. This contrasted with many of the studies reviewed in Chapter II in two ways. Initially, many of the gains from the cited studies in the review of literature rose from short-term interventions that were measured by comparing pre-tests and post-tests (HMH, n.d.-b, case studies M0327, M0325, A7385, A7387; Rivet, 2001; Riverdeep, 2005). Agodini et al. (2003) noted a tendency among researchers to publish studies with large effect sizes but the studies were conducted on a small scale, keeping the study from being generalized. Secondly, in two studies, the effect of *Destination Math* and *Destination Reading* were not separated (Eaton, 2005; Roberts, 2009).

This researcher utilized the MRV to simulate a control group. The math residual value used in this study allowed students to be compared to themselves in the context of the district population (Stone, 1999). There was a large sample size (n=3177). The MRV served as a measure of math performance. An effect size was included for each part of the analysis. Murphy et al. (2002) argued that all studies needed an effect size, a comparison group, a large sample size, and a reliable method to measure achievement.

This researcher included LEP Status as an independent variable. Hopstock (2003) felt that studies on LEP students must include the following: (a) a description of the subgroups of LEP, (b) a definition of LEP, (c) the institutional approach taken, and (d) how the students were assigned to groups. He also suggested that LEP and LEP-Monitoring students be grouped for the sake of the study. This researcher addressed the subgroups, defined LEP, and grouped LEP and LEP-Monitoring for the purpose of the study. There was not a discussion of how LEP students were assigned to groups, but it is assumed that LEP students utilized *Destination Math* in their normal math setting.

This researcher included Gender as an independent variable. Huff (2002) pointed out there were differences in software designed for girls and boys. Vale and Leder (2004) theorized that boys may still be more confident users of computers. Sanders (2005) indicated that more research was needed on gender and software. This study examined differences in residual performance based on Gender.

This researcher utilized quantitative usage data. This researcher did not find another study where the researchers measured Student Usage Level (SUL), Teacher Usage Level (TUL), and Campus Usage Level (CUL) in quantitative terms. Some researchers used the perceptions of teachers or students to classify usage.

This researcher utilized quantitative data to indicate the impact of the intervention. This researcher utilized a statistic that was based on the Texas Assessment of Knowledge and Skills, the Texas state assessment test, as the summative evaluation tool. Murphy et al. (2002) argued that it would be difficult to measure the impact of a specific piece of software. Kelly (2007) reinforced that products may help general problem-solving ability but may not help with specific tests. This study attempted to measure the impact of *Destination Math* on residual math scores on a district level.

This researcher added to the body of literature on *Destination Math* and its impact on students in a low socio-economic district. The district level studies in Victoria and St. Lucie were most applicable to the research in this dissertation. The Victoria researchers correlated the student usage with pre/post results. The St. Lucie researchers found that campuses with higher campus usage received higher school ratings from the state. This latter finding led the researcher to explore the CUL and the overall campus gains on the 2006 TAKS test to see if there was a relationship. Roberts (2009) appeared to aggregate the minutes from *Destination Math* and *Destination Reading* in the St. Lucie case study so it was difficult to attribute the positive results to only the *Destination Math* product.

Results of the Study

This researcher did not find a significant effect of *Destination Math* based on Teacher Usage Level (TUL) or Campus Usage Level (CUL). This researcher did find a difference between the Medium SUL and the Minimal and High SULs. This researcher focused on performance on a particular standardized test. Levenson and De Long-Cotty (2006) came to a similar conclusion concerning *Destination Math* with regard to fifth grade students. Researchers for the federal study (Trotter, 2007a) found no correlation between math software and test scores. While the federal study did not include *Destination Math*, the results of this researcher's study are consistent with the findings of the federal study. This result is contradictory to the numerous case studies that documented positive changes, but not necessarily significant changes, with the use of *Destination Math.*

Research Question 1

Do students who exhibit different utilization of *Destination Math* exhibit different math residual values among Student Usage Levels (SULs) of students in grades 3 through 11 in Xcellence Independent School District?

The mean of the math residual value (MRV) for the Medium Student Usage Level (SUL) was .11. The mean of the MRV for the High SUL was -.15. This was the greatest difference between means. The ANOVA calculation showed p=.013, effect size = .003, and power=.797. Because two of the three benchmark levels were met, the researcher conducted a post hoc test. The Ryan-Einot-Gabriel-Welsh F test indicated a difference existed between the Medium SUL and the High and Minimal SULs. Results from the *A priori* contrast indicated there was no significant difference between the combined Minimal and Low SUL when compared to the combined Medium and High SUL. Those students who utilized *Destination Math* for a greater amount of time did not exhibit significantly different MRVs than those students who used *Destination Math for* a lesser amount of time.

Levenson and De Long-Cotty (2005) indicated that too much exposure to the product, when used as a pullout, would decrease a student's time in the regular math class. Stoll (2000) indicated that time could be wasted on technology. Missing too much instruction could negatively affect a student's learning. Gabbard and Thomas (2007) were advised by Riverdeep to use *Destination Math* for 30 minutes a day, 3 days a week through pullouts. There is no definitive study in which the optimum amount of time to utilize the program is defined. The negative mean value for the High SUL would suggest that removing a student from the traditional math class to utilize a supplemental program may be a part of the deleterious effects on scores if the time is excessive. The mean of the Medium SUL was positive and the mean of the High SUL was negative, and the groups were determined to be different. The null hypothesis that residual math performance was not affected by student usage was rejected.

It should be noted that the MRV calculation for third grade is different from the calculation for other grade levels because there is no historical math data upon which to base the calculation. In Texas, students take the first TAKS test in third grade. It is possible that the calculation for the third grade MRV is not as accurate as the calculation that utilizes historic data. However, for this study, the results of third grade were combined with the results of the other grade levels.

Research Question 2

Do teachers of students who exhibit different utilization of *Destination Math* have students who differ in average math residual values (MRVs), among all students in grades 3 through 11 in Xcellence Independent School District?

The mean MRV for the Medium Teacher Usage Level (TUL) was .101. The mean MRV for the High TUL was -.046. This was the largest gap in the means of the TULs. The data for the means of the TULs (Table 26) followed the same pattern as the data in Table 21 for the means of the SULs. The Medium SUL had a positive mean MRV, while the High SUL had a negative mean MRV. If the Minimal and Low SUL classifications were combined, the combination would have resulted in a negative MRV. This is similar to the negative Low TUL.

The teachers who were classified as Medium TUL had students with a higher mean MRV than the teachers in the other TULs. However, the ANOVA yielded no significant difference between the TULs. The p value was .4. Therefore, Teacher Usage Level (TUL) was not a significant independent variable for residual math performance and the null hypothesis was not rejected. There were six teachers classified as High TUL. Five were from a third grade team from the one campus with a High Campus Usage Level (CUL). Because of this, the researcher decided to look at just the performance of the third grade students on TAKS across the district. There was an interesting pattern. The information appears in Table 37.

The greatest increase in third grade scores were accomplished by the three campuses with a Medium CUL. The greatest decrease in the district was achieved by the one school with the High CUL. The five third grade teachers at this school were all rated High TUL. This campus had utilized a lab setting and students worked with *Destination Math* as part of the regular class routine. It is theorized that the time in the lab supplanted regular instruction instead of supplementing it and, therefore, negatively impacted learning, as Levenson and De long-Cotty (2006) had theorized could occur. Stallard and Cocker (2001) argued that students would lose attention if placed in a lab setting for more than 20 minutes. It is also possible that students who were placed in a lab for periods of time greater than 20 minutes began to lose interest.

Table 37. Summary of 2005 and 2006 Third Grade Math TAKS Scores and Score Change for Each of the Elementary Schools

School	CUL	2005	2006	Change
Elementary 2	Low	80	75	-5
Elementary 4	Low	78	75	-2
Elementary 5	Low	93	90	-3
Elementary 7	Low	61	58	-3
Elementary 8	Low	83	83	+0
Elementary 10	Low	55	57	+2
Elementary 1	Medium	77	85	+8
Elementary 6	Medium	62	66	+4
Elementary 9	Medium	76	86	+10
Elementary 3	High	77	70	-7
District		73	74	+1
State		82	83	+1

Note. TEA, 2005, 2006a.

Research Question 3

Do students at campuses who exhibit different utilization of *Destination Math* exhibit different average math residual values among all students in grades 3 through 11 in Xcellence Independent School District?

The mean MRV of the Low CUL was -.006. The mean MRV of the Medium CUL was .001. The mean MRV of the High CUL was -.055. There was no significant difference among the CULs. The p value of .756 does not meet the $p \leq .05$ standard. Campus Usage Level of Destination Math did not improve the average MRV of students.

In the St. Lucie study, there was a correlation between campus usage and the school's state accountability rating. Therefore, this researcher decided to look at overall TAKS improvement for the campuses in XISD. There was no discernible pattern among the campuses, based on campus usage and overall campus improvement on the TAKS Math test. The results of the comparison between campus usage and campus TAKS achievement appear in Table 38.

There was an expectation by district level administrators that teachers would use *Destination Math*. Usage data were reviewed with principals. The majority of the schools were in the Low CUL.This researcher concludes that there was not a great campus emphasis placed on the use of the product. The one campus with a High CUL improved its math scores by one point. Three other elementary campuses had greater gains than the High CUL campus and four other elementary campuses had a higher average math score.

Table 38. Overall Campus TAKS Math Score Change for the Combination of Grades 3, 4, and 5 for all Schools in Xcellence ISD from 2005 to 2006

School	CUL	2005	2006	Change
Elementary 1	Medium	77	75	-2
Elementary 2	Low	86	74	-12
Elementary 3	High	75	76	+1
Elementary 4	Low	76	80	+4
Elementary 5	Low	86	83	-3
Elementary 6	Medium	66	70	+4
Elementary 7	Low	68	59	-9
Elementary 8	Low	85	91	+6
Elementary 9	Medium	84	84	+0
Elementary 10	Low	67	68	+1
Elementary – State		71	75	+4
Middle School 1	Low	39	43	+4
Middle School 2	Low	45	51	+6
Middle School 3	Low	47	52	+5
Middle School – State		71	75	+4
High School 1	Low	38	46	+8
High School 2	Low	36	42	+6
High School - State		71	75	+4

Note. TEA, 2005, 2006a.

Research Question 4

Do students classified by SUL, LEP status, and Gender exhibit different average math residual values (MRVs) among all students in grades 3 through 11 in Xcellence Independent School District?

There was no significant three-way interaction between the independent variables of Gender, LEP Status, and SUL. There was no significant two-way interaction between LEP Status and SUL, LEP Status and Gender, or Gender and SUL. There was no significant difference in residual math performance based on Gender or LEP Status.

In this study, there was no significant interaction between SUL and LEP Status. The probability level of the F-ratio was p=.599. Therefore, there was no need to look at simple main effects. The average MRV, based on LEP Status, was not significantly different. Bermudez and Palumbo (1994) felt that software that was media rich, nonlinear, individualized and interactive would be beneficial for a LEP student. De La Parte (2000) felt that, besides individualization, software that communicated in the student's native language would assist the student's learning. In contrast to this, it is unknown why LEP students did not improve residual math performance at a greater rate than nonLEP students. This could be an area for future study.

The probability level of the F-ratio for the interaction between SUL and Gender was p=.344. This researcher did not find indications that *Destination Math* utilized violence or competition in its design, indicators of male bias (Miller et al., 2001). Also, while the software contained interactivity, it was not structured like an action-oriented game. Thus, it should be considered gender neutral. Huff (2002) indicated that girls would perform worse with cross-gender software that they had to use in a public place. This should not have been a problem with *Destination Math.*

Conclusions From the Findings

Except for three SUL groups, the research in this study does not indicate that residual math scores would be significantly different with the use of *Destination Math*. There was a difference between the Medium SUL and the High and Minimal SULs. However, the effect size was .003. This is consistent with the data presented in the federal study. It is also consistent with Levenson and De Long-Cotty (2006). Other districts considering this program might achieve a comparative advantage when utilizing

Destination Math as a supplement to traditional instruction for a targeted group of students. This would be consistent with case study data.

Math TAKS scores in XISD increased from 2005 to 2006. It is possible that *Destination Math* served a role as an intervention tool and a tool for supplemental instruction to contribute to this improvement. This research does not support a positive relationship between usage and scores.

Recommendations

Recommendations to Riverdeep/Houghton Mifflin Harcourt for Application of the Study

This researcher finds that the lack of an ID number associated with each student usage record is a flaw in the *Destination Math* learning management system report on student usage. As a result, in order to pair student time with a corresponding performance score, an arduous process of matching up names had to be undertaken. This process could not be undertaken under the normal time constraints of a school district or campus. The Learning Management System (LMS) of *Destination Math* did not facilitate the exportation of data. Users must be able to export data as a .csv file or other format so the data can be easily extracted and combined with other information, including evaluation data.

At the Alternative School, where the program was utilized extensively, students were given a temporary ID to allow them to have accounts at their home school and at the Alternative School. When this researcher had to merge data, students who had attended the Alternative School had usage time from two locations that needed to be combined. Because the researcher utilized the student's campus location to match the student usage data to the student district ID, all the students at the alternative campus needed to be matched individually. This made it difficult to track a student's total usage in the system.

Usage data reports need to be adjusted. Initially, student usage data should be contained in one record. Currently, if two teachers use *Destination Math* with the same student, two usage records are created. Secondly, teacher usage data should contain presentation data time as a separate quantified amount. Campus data would contain the presentation time for teachers as well as student usage time. Thirdly, usage time for *Destination* Math and *Destination Reading* should be calculated separately. Finally, if not already worked in, the built-in timer that tracks usage should stop after a few minutes of inactivity.

Recommendations to School Administrators for Application of the Study

Implementing programs with fidelity helps determine if a program is actually effective (Dede, 1997). If the software is not implemented the way the vendor intended, it is difficult to blame the software if test scores do not increase. Therefore, district administrators should set expected usage and monitor it. Because the program does not track presentation data, this data could be collected with a qualitative instrument.

When schools purchase software programs, it is with a specific goal in mind. However, determining the evaluation piece often comes after the purchase of the software. As a result, schools do not map out a specific way to evaluate the effectiveness of a piece of software. Before software is purchased, school district leaders should insist that data be exportable. The data should be utilized in the formative and summative evaluation processes. The added value data served as its own control group as each student was measured against his expected performance, based on the performance of all students in the district. Only when the student exceeded his expected score did it register as a positive MRV. This made the MRV data effective as the dependent variable. District leaders must determine what quantitative measure will be utilized to evaluate a program's effectiveness. Districts that do not have access to added value data should use Lexile data for reading and Quantile data for math to measure growth.

Many administrators have a cutoff score they use to determine which students will receive an intervention. If this strategy is used, students on either side of the cutoff score can be compared after test results are received. This type of study is called a regression-discontinuity study and it is one of the new types of study that has been accepted by the What Works Clearinghouse. Schools that use *Destination Math* as an intervention tool can use this as a summative evaluation strategy.

If *Destination Math* usage is a district priority, the modules need to be integrated into the existing curriculum to maximize the effectiveness (Hoff, 2005). Technology alignment should start with the existing curriculum. Curriculum specialists in XISD worked with other school district specialists to develop a set of crossover documents that could be utilized to help teachers find *Destination Math* lessons that correlated to specific knowledge and skills statements specified in the Texas curriculum. These documents were made available in the Spring of 2006. The district began to integrate *Destination Math* lessons directly into the district curriculum in the Spring of 2007 when it purchased *Learning Village*, a curriculum management system that was also designed by Riverdeep.

Destination Math could be integrated with existing Algebra I curriculum to provide an additional presentation tool and remediation tool. This recommendation is supported by the Taepke Case Study in Covina Valley, California (HMH, n.d.-b, case study A7325) and the Taepke (2007) dissertation. Supporting Algebra I learning objectives will be particularly important to schools in Texas for the 2011-2012 school year as the state is moving to an End-of-Course system that will replace the TAKS test. The May 2012 ninth grade End-of-Course test in mathematics will be Algebra I.

There is a plethora of research that focuses on the effective implementation of technology in schools. Districts must consider staff development needs (Bozeman & Hiatt, 1999; Zhao et al., 2002), funding issues (Burbules & Callister, 2000), support for teachers (Cuban, 2001; Stallard & Cocker, 2001), correlation of software to assessment (Murphy et al., 2002), and integration of software into existing curriculum (Hoff, 2005). After reviewing the literature, this researcher developed the following list of questions that administrators should answer before they purchase instructional software.

- What are we targeting with this software?
- What evidence will we use to determine if we met that target?
- What are the hardware needs?
- What is the Total Cost of Ownership?
- What will be the furniture and power expectations?
- Will a lab be needed? If so, will a lab manager be needed?

- Who will set up the student accounts and solve problems at the campus and district level?

- How much money and time has been allocated for staff development? What will be the staff development schedule? How will it continue throughout the year? Will it continue after year one?

- Does the content of the software align with the state standards? If not, can learning modules be matched to the state standards? Who will do this work?

- Who will be responsible for the program evaluation? What will be the formative and summative components of the evaluation?

Recommendations for How to Improve the Study

This study could have been improved by including a qualitative piece for examination. Particularly, the following information could have been gathered from teachers:

- How did individual teachers utilize the program?
- Did they find it beneficial to students?
- What was their perception of the quality of the product?
- Did it assist with learning centers?
- Did it aid with individualization?
- What level of training did teachers receive with *Destination Math*? Did teachers feel it was sufficient to utilize the program effectively?
- Did teachers use *Destination Math* as a presentation tool?
- Was a lab setting effective?
- How many years of experience does the teacher have?
- Were there hardware or access issues that became a barrier?

Recommendations for Future Research

There are a number of possible follow-up studies that could be performed. Researchers could look at the effect of *Destination Math* on teaching style, the effect of teacher experience on software use, the effectiveness of the software by grade level, and the effect of multiple years of Destination Math on the same student. Time data could be analyzed to see if there is a difference in results when Assessment Time is increased as a percent of Total Time. The length of time a district has used *Destination Math* might be significant. Elementary versus secondary could be examined to see if the program worked better with a specific age group.

This researcher did not deal with the constructivist classroom and how technology facilitates this learning environment. This is an aspect of a software program that deserves study. Does the software help establish a more constructivist learning environment? State assessments, such as the TAKS test, measure math achievement but not creativity or, in most cases, general problem solving skills.

Would there have been a link between successful teachers and *Destination Math*? Taepke (2007) compared teachers to themselves two years later and found score gains. Should this have been expected? Levenson and De Long-Cotty (2006) suggested that years of teaching experience should be studied as a factor.

Future studies should use data from multiple years. Student usage can be tracked each year and merged into a master file. Students can be chosen at random and interviewed about the product. It is possible that students would get tired of the cartoon character in *Destination Math* after years of using the program. It is also possible that students would become secure with the character and look forward to the interaction each year.

Hardware and software support have always been a barrier to proper technology integration. In the last five years, the price-point for desktop computers, projectors, laptops, and peripherals has dropped. The dependability of the operating system and of the hardware itself has increased. Districts have begun implementing technology standards for all teachers. Each of these changes has increased the potential for effective technology integration in the classroom. New studies might avoid some of the hardware issues that were faced by some of the schools in this study. In an ever-changing world of technology, current schools have better hardware and better support. It would be easier for the research to focus on the actual effect and less on the barriers.

It would be interesting to ask the question: What were you doing before you purchased this software? If you did not purchase this product, did you have another strategy in mind? A survey like this might address the issues presented by those who do not feel technology is the way to improve test scores.

The researcher did not explore the role of the principal in terms of the implementation of *Destination Math*. Other researchers might ask the principal if the program was considered a valuable tool in the school’s instructional program. This could be compared to campus usage levels.

Summary

While there are a number of cited studies that document score gains with *Destination Math*, this researcher did not find that residual math scores were significantly different among teacher or campus usage groups. While there was a significant difference between the student usage groups, High users exhibited negative MRVs. The results of this study are consistent with another large quantitative study that involved *Destination Math*. This researcher feels that there are an ample number of studies that provide evidence that *Destination Math* can have a positive effect on student math performance. However, the program should not be purchased with the intent to improve significantly the residual math scores.

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APPENDIX A

STEPS UTILIZED TO CONSTRUCT THE DATABASE

Step 1
Create the Usage files; convert from HTML to Excel; remove hyphens

There were four Usage Tables in html format that were downloaded from the *Destination Math* monitoring software the day before TAKS testing started. These tables were: Student Usage, Campus Usage, Teacher Usage, and Class Usage. Each of the Usage Tables was copied/pasted from the html document to an Excel spreadsheet. The cells of the spreadsheet had been pre-formatted as text cells and the copy/paste utilized the ‘keep destination formatting’. When the data was copied from the html file, there were hyphens between all the names in the cells. These were removed with a global replace routine. This caused a problem later as students with hyphenated last names did not match up to their respective names in the database (since the hyphens had been removed from the usage table). An example of a data line from the Student Usage table appears in *Illustration 1*.

Illustration 1: Example of a data line in the Student Usage table.

A	B	C	D	E	F
School	**Teacher**	**Class**	**Student**	**Instructional Time**	**Assessment Time**
MIDDLE SCH 1	ANN SMITH	231611	JANICE SAMPLE	2 hours, 26 minutes	0 hours, 0 minutes

Step 2
Utilize a conversion program to create a numeric value for time and copy the numeric values for time over the text values for time

In order for the data to be utilized in a quantitative manner, the time displayed in the Usage Reports had to be converted from a text field of the form “2 hours, 26 minutes” into a numeric field with the form “2.43” with a unit of ‘hours’. To accomplish this, a special spreadsheet was designed to convert the time into an equivalent numeric value. The time columns from each of the Usage Reports were copied and pasted into the conversion worksheet. The conversion was performed. The resulting column was copied and pasted over the original column in each of the Usage Reports. The entire procedure is detailed in Illustration 2. The entries in the last two columns in *Illustration 2* (Example 1 and Example 2) represent how the time data was altered throughout the process.

Illustration 2: Procedure for Converting the Time

Conversion Step	Explanation of Procedure	Example 1	Example 2
Original data		6 hours, 1 minutes	12 hours, 23 minutes
1) Convert Minutes	Global replace for “1 minutes” to “01 minutes”. The same procedure was done for 2, 3, 4, 5, 6, 7, 8, and 9.	6 hours, 01 minutes	12 hours, 23 minutes
2) Remove “hours”	Global replace from “ hours, “ to “.” There is a space before and after the comma in “ hours, “	6.01 minutes	12.23 minutes
3) Remove “minutes”	Global replace for “ minutes” to “”	6.01	12.23
4) Subtract hours	Subtract the hours portion and put the result in a new cell: Cell – int(number)	.01	.23
5) Convert to fraction of an hour	Cell*100/60; round to the hundredths	.02	.38
6) Add hours back	Newcell + int(number)	6.02	12.38

Illustration 3: Formulas for converting time – *Conversion Worksheet*

A	B	C	D	E
Reference	**Conversion Macro (original)**	**Subtract Hours "cell - int(cell)"**	**Convert to Fraction of Hour "cell*100/60"**	**Add Hours back "cell+int(original)"**
	Appendix A	=B2 - INT(B2)	=C2*100/60	=D2+INT(B2)

A spreadsheet entitled “Conversion Worksheet” was created to perform the conversion process listed in Illustration 2. The “Instructional Time” column from column E in *Illustration 1* was copied and pasted into columns A and B of Conversion Worksheet (shown in *Illustration 3*). Column A served as a reference column to spot check that the conversion had taken place correctly. An Excel macro was run to convert the values in column B from the text form to the numeric form demonstrated in *Illustration 2*. The macro performed conversion steps 1, 2, and 3 used in *Illustration 2*. The spreadsheet utilized the new data format in column B of *Illustration 3* to complete steps 4, 5, and 6 in *Illustration 2.* The respective results appeared in columns C, D, and E in *Illustration 3*. Column E represented the final converted time. (side note: Columns C, D, and E could have been collapsed into one column, using the formula *=INT(B2)+(((B2-INT(B2))*100)/60)* The researcher chose to keep the three columns for illustrative purposes).

The result of column E was pasted on top of the original values of column E in *Illustration 1*. The column was pasted as “values” so that the numeric values would be transferred – not the formula that produced the values. The value was formatted to show the result to the hundredths place. This procedure was repeated for the “Assessment Time” data in column F. It was then repeated for all the time data in the other three Usage Reports. A sample of the converted table appears in *Illustration 4*.

Illustration 4: Usage Data with time converted

A	B	C	D	E	F
School	**Teacher**	**Class**	**Student**	**Instructional Time**	**Assessment Time**
MIDDLE SCH 1	ANN SMITH	231611	JANICE SAMPLE	2.43	0.00

Step 3
Classify student use; delete rows that cannot be used

Illustration 5: Student usage – converted – with changes

A	B	C	D	E	F	G	H	I
Camp ID	School	Teacher	Class	Student	Instructional Time	Assessment Time	Total Time (=F2+G2)	Stratified Use
222	MID SCH 1	ANN SMITH	231611	JANICE SAMPLE	2.43	0.00	2.43	Medium

The student usage data table was utilized for this first procedure. The campus number was inserted as Column A (*Illustration 5*). The data for this column was typed in. Column A was formatted as 'text' so that the lead zeroes for campus numbers would not be lost. The total time was calculated in column H. The table was sorted on the total time. The data was examined and a preliminary attempt to stratify users was made. The information was added to Column I using the following criteria for "Stratified Use":

- Non – 2845 entries – less than 30 minutes
- Low – 2084 entries – less than 2 hours but greater than or equal to 30 minutes
- Medium – 2215 entries – less than 6 hours but greater than or equal to 2 hours
- High – 1499 entries – greater than or equal to 6 hours

Rows were deleted that did not represent student use. The following deletions were made:

- Column E – teacher name instead of a student – 4 entries
- Column B – non-school names (such as Riverdeep Training School) – 602 entries

Step 4
Eliminate grade levels that are not in the study

Column D in *Illustration 5* was converted from numeric to text. The following grade levels were deleted: K, first and second. These grades were identified easily as the class number was three digits and the hundreds place was a 0 (kindergarten), 1 (first grade), or 2 (second grade).

Step 5
Construct an Access database with the necessary student scheduling information, and population data

At this point, an Access database was established. A set of data tables from the district's data depository – the ITCCS system - were downloaded on April 3, 2006 and archived for later use. These tables were used to construct the student information records. Each record contained the following information: campus number, state ID, local ID, grade, last name, first name, course/section/period (secondary only), teacher local ID, teacher first, and teacher last. This database contained all the scheduling data so there were multiple records for each student (each record contained information on a different class the student was taking). *Destination Math* was utilized through the math classes. Therefore, in a subsequent step, a subset of this data would be extracted to provide a set of records that included students with the course/section information from their math class.

Step 6
Create a database from the INOVA data

The district had purchased an analysis of its data from The INOVA Group. The data included actual TAKS data as well as special populations data (as it appeared on the individual student TAKS answer documents) and objective data from the TAKS test. This data arrived as a spreadsheet. An Access data table was created from the spreadsheet. The data table included the following fields: state ID, grade, last name, first name, date of birth, gender, LEP status, and math residual value (MRV).

Step 7
Create a database of the usage data

The data from *Illustration 5* was imported into an Access data table. All of the columns were imported. The columns were: Campus ID, School, Teacher, Class, Student, Instructional Time, Assessment Time, Total Time, and Stratified Use.

Step 8
Create a data table of all math teachers for every student

A set of dataqueries were written to extract the scheduling information to isolate the math teachers for every student. Since the original *Destination Math* data table had been constructed using students and math teachers, this seemed the best way to match up students and insure that the matching process between Usage data and ID data occurred correctly. The following columns were created: campus, state ID, local ID, student name (first last), course/section, teacher.

The data for secondary students included the course and section number for the math class. In the Usage table, this was listed as a six digit number. This was one of the three fields used to match the student listed in the usage data to the student listed in the ITCCS data. The data for the elementary students included the three digit teacher number for the homeroom teacher.

Step 9
Match up as many students as possible in the Usage database to students in the ITCCS database in order to get a local ID and a state ID

There were three fields that, when matched, would virtually guarantee that the correct student in the usage table would be matched up to the correct student in the ITCCS database: name, course/section, and campus. The only possibility for an incorrect match would occur if two students with the exact same name were in the same math class or elementary homeroom. It was understood that numerous students would not match up. Below is a list of the possible things that could keep the student from matching:

- The student switched schools within the district during the year.
- The student was added by the teacher and the typed name did not match the ITCCS database name exactly.
- The teacher had set up a group that was not named with the teacher number (elementary) or the course/period number (secondary).
- The student had a hyphen in his/her name that was deleted with the initial hyphen removal technique.

The query that was written to match the data contained two limiters: state ID was greater than zero and total time was greater than zero. This accomplished two things. Initially, it eliminated all those students who did not match up and thus did not have a state ID number. Students who did not match up would have no state ID from the merge. Secondly, it eliminated all those students who had no usage time. The researcher did not feel it was important to match up students who had no usage time. This first step produced 3459 records.

Step 10
Discover the state ID and the local ID for as many of the remaining students as possible

Using a similar strategy to the one explained above, the records of all the students whose state ID equaled zero (and whose usage time was greater than zero) were selected. This operation produced 1295 records. This was exported as a spreadsheet and appended with the names of every student in the district, populating the following columns: school number, student name, local ID, and state ID. The additional 9500 entries, representing the entire district enrollment, brought the number of rows up to 10,795.

This new spreadsheet was sorted with the following criteria: campus-ascending, student name-ascending, class-ascending. As a result, if a student’s campus and name matched, his/her entry with the ID data would appear above the entry with the usage data (because the usage data contained the class information and this would be sorted beneath the blank entry in the row with the ID data).

Illustration 6: Usage data merged with entire student population

	A	B	C	D	E	F	G
1	**Campus ID**	**School**	**Teacher**	**Class**	**Student**	**Instructional Time**	**Assessment Time**
2	041				JUAN DEMO		
3	041	MID SCH 1	ED JONES	Period 8 G6	JUAN DEMO	3.86666667	0.3

H	I	J	K
Total Time	**Stratified Use**	**State**	**Local ID**
		631234567	234567
4.166666667	Medium		

The researcher attempted to find matches for the students without ID numbers. If a match was found, the values from columns J and K were copied into the row that was missing the data. If two names matched the name with the missing data, no ID information was copied. Along the way, 8 additional records were discovered that did not represent students and these were deleted, leaving a total of 1287 records of the original 1295. After utilizing this technique, ID numbers were found for 867 students. Four hundred and twenty still did not have ID information.

The file was then sorted on name and total time to integrate all schools. Many students from the alternative school were not matching names in the database. If a unique matching name was found at a secondary campus, the ID information was copied. This process also worked in reverse for students who were assigned to the alternative school but had time data at one of the secondary schools. If a unique student match was made with a name from another campus at the same level (elementary, middle school, high school), the ID information was copied. All others were left blank.

To expedite the process of copying ID data, a macro was written. To use the macro, the cell in column I was selected next to the name of the student that needed the data. In the sample in *Illustration 6*, the cursor would be placed on cell I2. The macro copied the values for J and K. In this example, J2 would appear in J3 and K2 would appear in K3. If the matching name appeared in the row below the student (as occurred for students with a hyphenated name – all hyphens had been removed earlier), then the values in columns J and K were copied manually. The procedure for matching up ID numbers took approximately 1.5 hours.

From the procedure above, the 9500 student population that had been added (no usage data) were deleted. This left the original 1287 rows. Out of this, 999 students had ID data. This left 288 that did not have ID data. The data was analyzed and the following breakdown was noted (based upon the original student usage level definition):

- Nonusers – 56
- Low – 157
- Medium – 56
- High – 19

The research did not feel the loss of this data would impact the study so these lines were deleted. The original file with 3459 records and the new file will 999 records were merged into one file.

Step 11
Combine the times of students with multiple entries into one total entry

The new spreadsheet with the usage data was sorted by state ID. Then, a formula was utilized to find students with multiple entries. The formula column was copied and the values pasted in Column L. A sample appears in *Illustration 7*.

Illustration 7: Process for determining duplicate student names

	A	B	C	D	E	F	G
1	Campus ID	School	Teacher	Class	Student	Instructional Time	Assessment Time
2	333	ELEM 1	ANN SMITH	502	June Jones	2.3833333	0
3	333	ELEM 1	ANN SMITH	502	June Jones	0.5833333	0

	H	I	J	K	L	M
1	Total Time	Stratified Use	State ID	Local ID	values from M	formula
2	2.383333333	Medium	123456789	234567	1	=IF(J3=J2,"1",IF(J2=J1,"1",""))
3	0.583333333	Low	123456789	234567	1	=IF(J3=J2,"1",IF(J2=J1,"1",""))

The file was sorted on “values from M” in column L in *Illustration 7*. The 3299 students that did not have duplicate entries (value not equal to 1) were saved in a separate spreadsheet to be merged back later. These were removed from the active spreadsheet. The remaining list represented all the students with duplicate entries. It was sorted by SSN. The entries in Columns L and M were cleared. Column L was renamed “new instructional time” to indicate the total of all time for that student. The following formula was utilized:

=IF(J2=J6,SUM(F2:F6),(IF(J2=J5,SUM(F2:F5),(IF(J2=J4,SUM(F2:F4),(IF(J2=J3,SUM(F2:F3),""))))))

This created a total usage time for a student who had between 2 and 5 multiple entries. The student’s first entry contained the total time. If the student had 3 to 5 entries, there would be smaller sums next to all the successive entries except the last. A similar technique was utilized to sum the time for “Assessment Time” and “Total Time”. An example appears in *Illustration 8*.

Illustration 8: Process for adding time for multiple entries

	E	F	G	H	I
1	Student	Instructional Time	Assessment Time	Total Time	Stratified Use
2	ERNEST EDWARDS	0.55	0	0.55	Low
3	ERNEST EDWARDS	0.8333333	0	0.833333333	Low
4	ERNEST EDWARDS	0.8333333	0	0.833333333	Low
5	ERNEST EDWARDS	1.95	0	1.95	Low
6	ERNEST EDWARDS	10.6	0.11666667	10.71666667	High

	J	K	L	M	N
1	ssn	Local ID	new instructional time	new assessment time	new total time
2	123456789	234567	14.76667	0.116667	14.88333
3	123456789	234567	14.21667	0.116667	14.33333
4	123456789	234567	13.38333	0.116667	13.5
5	123456789	234567	12.55	0.116667	12.66667
6	123456789	234567			

A simple coding technique was utilized to count the different types of multiple entries. The classification of the multiple entries that appeared is listed below:

- Students with 2 entries: 427
- Students with 3 entries: 66
- Students with 4 entries: 23
- Students with 5 entries: 3

Duplicate entries were deleted, leaving only the student entry that represented the sum of all accumulated time. In *Illustration 8*, rows 3 through 6 would be deleted. This left 519 entries. The stratified use column was reexamined since time had been combined. Values were changed to match the original Usage definition:

- Non user – less than .5 hour
- Low user – greater than or equal to .5 hour, less than 2 hours
- Medium user – greater than or equal to 2 hours, less than 6 hours
- High user – greater than or equal to 6 hours

The resulting data was merged with the students with unique entries that had been set aside earlier. The 519 records were combined with the 3299 records that had been set aside before. The new file contained 3818 unique student records with usage data and ID data.

Step 12
Import usage data back into Access and match it with the appropriate demographic data and residual data

The spreadsheet was loaded into Access. A query was designed to match the Usage data with the INOVA data in order to add the following information to each record: LEP status, Gender, and MRV. Two criteria were utilized to filter the results. STDRM<>0 was used to eliminate students who did not take the math TAKS and had no data. Total Time>0 was utilized to remove any students who had residual data but did not have any usage data. The Make Table function was utilized to create a usable data table. This table was exported into a spreadsheet. The new table contained 3177 records. STRDM<>0 excluded 399 records of students who had usage data but did not have any residual data. This data was exported to create the SPSS data spreadsheet.

Step 13
Recode data before exporting to SPSS

The campus usage report was utilized to categorize the level of use by campus. The campuses, the total usage time, and the classification appear in *Illustration 9.* The usage classification data was added as a column to the SPSS data spreadsheet. In addition, all campuses were identified as 1 (secondary) or 2 (elementary).

Illustration 9: Time Usage by Campus

Type	School	Pop gr 3-11	Inst.	Assess.	Total Time	Classific.
1	ELEMENTARY 3	3-5	5426.38	871.55	6298	High
1	ELEMENTARY 1	3-5	3852.10	104.98	3957	Medium
1	ELEMENTARY 6	3-5	2870.25	306.07	3176	Medium
1	ELEMENTARY 9	3-5	2771.07	107.17	2878	Medium
1	ELEMENTARY 2	3-5	1547.65	96.47	1644	Low
1	ELEMENTARY 7	3-5	1348.82	282.98	1632	Low
1	ELEMENTARY 10	3-5	1410.72	166.07	1577	Low
1	ELEMENTARY 4	3-5	1355.52	66.98	1423	Low
2	MIDDLE SCHOOL 1	6-8	1314.48	20.52	1335	Low
1	ELEMENTARY 5	3-5	872.73	26.28	899	Low
2	MIDDLE SCHOOL 1	6-8	868.83	20.63	889	Low
2	HIGH SCHOOL 2	9-11	650.52	52.23	703	Low
2	MIDDLE SCHOOL 2	6-8	660.85	2.97	664	Low
1	ELEMENTARY 8	3-5	568.42	57.83	626	Low
2	HIGH SCHOOL 1	9-11	373.08	1.90	375	Low

Teacher usage was stratified using the classifications in *Illustration 10*. Teacher usage was added as a column to the SPSS data spreadsheet. Because secondary teachers service more students, their total usage time needed to be at least 750 to qualify for the Medium category. The greatest use was by one teacher whose students logged 629 hours. Therefore, no secondary teacher was classified as a High or a Medium user.

Illustration 10: Teacher Usage

Total Usage (hrs)	Classification	# of Elem. Teachers
500 and above	High	6
250 – 499	Medium	13
below 250	Low	245

After further consideration, Usage time classification by student was altered to meet the criteria in *Illustration 11*.

Illustration 11: Classification of student usage time

Hours of Use	Classification	Number of students
20 and above	High	97
10 – 19.9	Medium	302
5 – 9.9	Low	494
below 5	Minimal	2284

These classifications were based on a subjective supposition that the program would be used at least 45 minutes a week for a student to be considered a High user.

Before the data table was exported to SPSS, the following changes were made:

- The campus number and the teacher name were deleted
- All stratified use data was converted to a numeric representation
- LEP status was converted to a numeric representation
- Grade level was converted to a numeric field
- Gender was converted to a numeric field
- All specific student references, including name and ID numbers, were deleted; students were assigned a row number and this served as the record identifier

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